CASAS – Comprehensive Adult Student Assessment Systems

Technical Manual

Math Assessments

Employability Competency System (ECS)

Workforce Learning Systems (WLS)

January 2010

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(a) Format of the Technical Manual

This manual provides the technical information related to math assessments developed by the CASAS – Comprehensive Adult Student Assessment Systems. These assessments include *Employability Competency System (ECS) Math Assessments*, which include forms from the *Workforce Learning System (WLS) Math Assessments*. For simplicity, all forms covered in this manual will generally be referred to as the ECS Math Assessments.

The *General Information* section describes the purpose of the aforementioned assessments and lists all test forms that are covered in this manual.

The *Development* section describes the process used to create the ECS Math Assessment and assign items to test forms. The psychometric properties are analyzed for all items in the item bank and for the complete test forms.

The *Maintenance* section includes information about publishing dates for the ECS Math Assessments, steps taken to ensure score comparability across test forms, steps taken to maintain the security of the assessment, and a history of the assessments use.

The *Content Validity* section includes information on the match of the content to the NRS Educational Functioning Levels, the competencies measured by the Skills Math Assessments, and the subject matter experts involved in the determination of content.

The *Standard-Setting Procedures* section describes the procedures used to establish cut scores for each NRS Educational Functioning Level and the standard error of measurement for each cut score.

The *Reliability* section includes information on the correlation of scores across alternate or parallel test forms and a description of the research designs used to test the reliability of the ECS Math Assessments.

The *Construct Validity* section includes information on the comparability of the ECS Math Assessments with other assessments designed to assess educational gain, the extent to which performance on the math assessments is related to other related measures of the intended construct, and analyses regarding practice effects.

The *Other Information* section includes information on the determination of test administration time, appropriate modifications, recommendations for retesting, and future development plans.

(b) General Information

Item b1 – A statement, in the technical manual for the test, of the intended purpose of the test and how the test will allow examinees to demonstrate the skills that are associated with the NRS educational functioning levels

The intended purpose of the *Employability Competency System (ECS) Math Assessments,* which include forms from the *Workforce Learning System (WLS) Math Assessments,* is to measure the NRS educational functioning levels of members of the youth and adult education population in the content domain of math.

This series includes two (or more) secure and parallel equated forms at each of four difficulty levels. Agencies are able to use four distinct test levels to place and subsequently to measure educational gains for learners as related to all NRS educational functioning levels of ABE/ASE.

These assessments are appropriate for use with learners with beginning to advanced level math skills (in ABE/ASE programs from ABE beginning literacy to adult secondary education). The direct relationship between the NRS educational functioning levels for ABE/ASE programs to the CASAS scale score ranges is covered under Item f3.

The *ECS Math Assessments* can be administered as traditional paper-and-pencil tests or as computer-based assessments.

The basic skills content standards as measured on the *ECS Math Assessments* relate directly to curriculum content, which in turn allows test results to inform instruction and program improvement. *ECS Math Assessments* are one of the key components in an integrated system that links curriculum, instruction, and assessment. CASAS develops assessments based on specifications that include learner goals, basic skills content standards and life skill competencies, range of test difficulty level, and curriculum. The *ECS Math Assessment* test items are written in functional life skills contexts that include applied math in a variety of employment preparation and workplace situations.

Item b2 – A summary of the precise editions, forms, levels, and, if applicable, subtests and abbreviated tests that the test publisher is requesting that the Secretary review and determine for suitable use in the NRS

Table b2-1 lists the twelve ECS and WLS Math test forms included in this manual. In addition to these 12 forms, there are several forms that are not used for the NRS reporting but are used as appraisal/locater instruments. The CASAS test level (A-D), number of items, test use, and computer-based testing (CBT) availability is listed for each form. For a comparison of CASAS test levels to NRS educational functioning levels, please refer to Tables f3-1 and f3-2.

Table b2-1 ECS and WLS Math Test Forms

Form	Test Level	No. Items	Test Use	Computer Based Testing Availability
11	A	24	progress (pre/post testing)	Yes
12	A	24	progress (pre/post testing)	Yes
13	B	31	progress (pre/post testing)	Yes
14	B	31	progress (pre/post testing)	Yes
213	B	30	progress (pre/post testing)	Yes
214	B	30	progress (pre/post testing)	Yes
15	C	31	progress (pre/post testing)	Yes
16	C	31	progress (pre/post testing)	Yes
215	C	32	progress (pre/post testing)	Yes
216	C	32	progress (pre/post testing)	Yes
17	D	32	progress (pre/post testing)	Yes
18	D	32	progress (pre/post testing)	Yes

(c) Development

The CASAS assessment system is comprised of assessment instruments that serve a variety of purposes. The major test series are used in adult education classes and training programs to measure student learning gains in reading comprehension, listening comprehension, math, writing, and speaking. The reading, listening, and math series consist of multiple-choice test items that can be administered as pre- and post-tests across a range of student ability levels in a life and work skills context.

The first CASAS test forms were created in 1981. New tests have been created over the ensuing years to expand or strengthen the CASAS assessment system. As test items are developed, they are placed in an item pool. New multiple-choice test forms and modes for delivery are constructed from this calibrated item bank.

Establish Test Design

The purpose and parameters of a CASAS test development project are set collaboratively with the National Consortium or the state or agency requesting the test and CASAS staff.
The main considerations in designing a new CASAS assessment include:

I. Purpose of test
   a. Appraisals, progress tests and certification tests will differ in length, scale score range, content coverage, etc.
II. Content Focus
   a. General focus: life skills, general employability, workplace, or other.
   b. Specific: the basic skill content standards and competencies that relate to NRS Education Functioning Levels.
III. Modality, item types, and breadth and depth of coverage to be included
   a. For math tests, there are a number of item types that assess different math skills.
IV. Level and range of difficulty
   a. Difficulty of item content, the complexity of the items, and the cognitive level of the skills to be assessed.
V. Test length
   a. A natural constraint on the range of skills and competencies that can be assessed.
VI. Need for Parallel Forms
   a. Appropriate items are needed to create two forms that are parallel in content coverage and range of difficulty.

Determine Item Development Needs

CASAS items are developed in response to a request for an approved test development project or to expand an existing item pool to meet future test construction needs. When item development is targeted to a specific assessment development project, a needs assessment is conducted to identify the priority content and skill areas to be measured for each assessment. For assessment development intended for adult education programs, adult education professionals are surveyed to identify and prioritize relevant content domains, usually expressed in the form of life skill

competencies and basic skill content standards. Surveys are prepared and distributed or electronically disseminated to adult education agencies across the country. The results from these surveys provide guidance to item and test development.

In addition to identifying target content domains, an initial step in planning item development is identifying the number of items that need to be created. Items undergo an extensive review and pilot testing process and item attrition will occur at several stages of the process. About three times the number of items needed for the final calibrated test form are generated during the item development process. For example, if two 32-item test forms at an intermediate adult proficiency level are needed, 200 initial draft items are written to ensure a minimum of 80 calibrated items are available for selecting the final test forms and items. This provides flexibility to have enough calibrated items that are aligned with the test specifications for both content coverage and range of difficulty on a test form.

Qualified Item Writers

CASAS engages item writers in addition to the CASAS item and test development staff to contribute to item writing projects. Item writers are selected on the basis of:

- experience in adult education (teaching, curriculum development), with adult ESL and ABE populations for which the tests are intended
- familiarity with the language and cultural issues and life experience of ESL and ABE populations; and with the real-life language and literacy needs of adults in society
- successful experience in writing test items, assessment materials and curriculum
- academic background that relates to their language or literacy teaching expertise
- demonstrated ability to write to specific test blueprint specifications and standards
- having completed fairness and sensitivity training

Potential writers receive a day-long training by a master item writer that includes theory and practice in test development. The training covers the CASAS item writing/editing guidelines, (see "*Criteria applied in the editing process*" below) the CASAS competencies and basic skills content standards, as well as practical exercises in writing items to specific targeted competencies and standards. Item writers who are selected are mentored by master writers, who give specific feedback on their work in order to build skills. The progression of draft items illustrates the development of test items from initial draft to final form for pilot testing. Item writers occasionally come together for group writing and review sessions with qualified editors where additional guidelines or advice on content and on item development issues are discussed.

Item writers are given detailed test blueprint specifications, including specific competencies, basic skills or content standards, at a specific targeted instructional level. Copies of all source material are submitted with draft items to CASAS. Item writers follow established procedures, including confidentiality and non-disclosure policies, in preparing, organizing and submitting their draft item materials.

Item Development and Editing

Draft items are submitted to the CASAS Item and Test Development Department to review and edit. Three to four test development professional staff review and edit each draft item. This is essential, as different perspectives and interpretations can be brought to the material. If an initial draft item requires major revision or a change in focus or complexity, it is returned to the original writer with specific feedback to be revised. Other revisions are made by the CASAS test development team. The team also does some initial item development.

The lead editor is responsible for compiling the multiple edits and discussing them with the editing team as a whole to reach a consensus on the final revisions, and a final pilot test version of the items is compiled. Further refinements to items continue to be made through the entire development process, from this "final" draft, to clinical tryout to pilot to field-test stage.

Criteria applied in the editing process include the following questions:

- Were the initial item criteria met (e.g., level, Content Standards, competency)?
- Are all parts of the content as free as possible of potential biases (e.g., age, race, gender, ethnic background, specialized knowledge)?
- Could any part of the content be considered tricky?
- Is the display easily accessible (i.e., it is something that could be encountered in daily life)?
- Is there any cultural bias? (Please refer to Item c2i for a description of the *CASAS Fairness and Sensitivity Review Process.)*
- Does the group of items intended for a pilot or field-test form have diverse ethnic and gender representation (e.g., names, roles)?
- Does the item test what it is intended to test?
- Is the stem of the test question and distracters clear and direct?
- Is the stem phrased in the positive form?
- Can the item be answered solely from the information given? (i.e., Is it a knowledge question? Is information from another item needed to answer the question?)
- Is there only one best answer?
- Are all options plausible?
- Are all options homogeneous in content and length?
- Are options containing numbers presented consecutively when possible?
- Is grammar and punctuation correct?

Conduct Clinical Tryout

During the item drafting process, a small-scale clinical tryout of certain items may be conducted, especially if there are uncertainties as to level of difficulty or relevance of topic, or if a new assessment strategy approach is being tried. Items will be placed on an informal test form and administered in several adult education classes by CASAS development staff to gain more

insight on how examinees respond to the item. Classes that are representative in terms of the learner population for whom the final tests are intended are chosen for this exercise. On the basis of the results of the clinical tryout, a shift in direction or leveling in item development may be made.

Conduct Pilot Testing

When the editing process has resulted in an acceptable number of final-draft items, the items are sent to the production staff for formatting in preparation for the next step of pilot testing. This stage is important especially in discovering flaws in items and noting general reactions to the test items from teachers and students. In the pilot test, draft items are assembled into item test forms and administered to a total of approximately 100 students in classes at two or three schools that are representative of the target population for the final test forms in terms of ability level, gender, age, and ethnic group. The pilot tests are administered by teachers who have training and experience in administering CASAS tests. The teachers are provided a feedback form to record teacher and student comments on the test items.

An item analysis is computed from the pilot test and the results are reviewed by the CASAS test development, editing and psychometric staff. Teacher and student feedback is also reviewed. The evaluation criteria for the pilot test follow the same general criteria as analysis of the field tests discussed below. The CASAS editing team identifies and corrects any item flaws suggested by the statistical item and option analysis including, for example, incorrect options being interpretable as correct; lack of clarity in the wording of questions, options, or prompts; and distractors that are not attractive to examinees. Items that have content that is not seen as appropriate to certain demographic groups are either revised or dropped. The draft items that have no problems – and those with flaws that have been edited, revised or modified – are then ready for formal field testing. It is vital that any problems with the items be resolved before items are placed on item field tests, after which further revision cannot be made without additional field testing.

Conduct Item Field Test

The best-performing items from the pilot test are selected to be placed on item field-test forms. Selection is made on the basis of the item analysis statistics from the pilot tests, anecdotal information from teacher feedback, and appropriate coverage of the competencies and basic skills identified as priorities for the final test forms to be constructed. Consideration is also given to achieving variety and balance in difficulty, content and display type (e.g., narrative text, chart, graphic) as well as in gender and ethnic representation. The items placed on the field test forms need to meet all the content domain and psychometric requirements identified in the initial project planning and test blueprint specifications, since the majority of calibrated items for the final operational test forms will come from this set of items. The remainder may come from calibrated items already in the item bank that meet the test blueprint specifications.

To allow for linking of results from each of the field test forms to the standard CASAS measurement scale, 8 to 10 linking items from the item pool are included on each of the item field-test forms. The difficulties of the linking items should range from an expected p-value of

.40 to about .70; they should have point biserial correlations of at least .30; show good high and low group discrimination of .30 or above; and have content compatible with the draft test items being field tested. A representative set of linking items is selected to measure examinees at different positions within the ability continuum.

Administration of the field tests to the appropriate population is vital to the success of the process. To ensure a total minimum *N* of at least 300, approximately 500 to 600 copies of each form are sent out. Agencies are selected based on diversity of size, population served, in urban and non-urban areas in a range of states. Classes at an instructional level corresponding to the test level are selected. The final sample size includes some students above the targeted instructional level and below the test level. Instruction in participating classes needs to be related to the domain being tested. The field tests are administered by teachers or other staff who are trained to administer CASAS tests. Test administrators receive detailed instructions on how to administer the test, collect student information, and provide for test security before, during, and after testing.

In addition to program and class level, information collected on students includes gender, age, ethnic background, native language, and number of years of education. Test administrators complete structured feedback forms to record teacher and learner comments and observations on specific test items, on the test overall, and on the testing process. The number of participants for the *ECS Math* tests (agencies and examinees) and the examinees' demographic information is included in Tables c1i-1 and c1ii-1 to c1ii-2.

As completed answer sheets are returned to CASAS, numbers are tallied to ensure that the overall *N* will be achieved and that the diversity of level and population is being obtained; if these are not the case, more field tests are sent out to representative populations.

Analyze Results of Field Test

When a sufficient number of field-test forms have been received, the answer sheets are scanned and statistical analyses are completed. Statistics for each item include classical item analysis showing for each response option: the p-value, biserial, point biserial, discrimination index, and breakdown by high and low-performing examinees; overall test form performance statistics; breakdown of *N* by agency and level; and student demographics. Based on the analyses of these data, additional analyses and reviews are conducted by item writers and SMEs as necessary.

The main statistical criteria considered in determining item viability can be summarized as follows:

- point biserial (minimum 0.30 acceptable)
- p-value (ideally between 0.30 and 0.80)
- high and low group discrimination index (higher than 0.20 is desirable)
- option choice by high and low-performing examinees
- percent on option choices, including non-response
- overall mean percentage test score (between 0.40 and 0.70)
- infit-outfit statistics (between 0.7 and 1.3)
- estimated IRT discrimination

- lower asymptote (examined if greater than 0.10)
- item bias data (please refer to Item c2i detailing CASAS Fairness and Sensitivity Process)

The comments and reactions collected from test administrators and students are compiled and carefully reviewed to identify possible bias, formatting issues, or other problems with items.

Items that show poor performance on the basis of statistics or other factors are flagged for review. Items whose topic or content was considered by teachers and students to be objectionable, inappropriate, questionable, of little relevance, etc., are deleted. In other cases, items can be returned to the editing stage and reworked for possible additional field testing.

Table c-1 provides a summary of field test items that were dropped from CASAS assessment series.

Table c-1 CASAS Field Tests – Summary of Removed Items

Test Series	Number of Final Test Forms Created	Number of Items Removed During Field-Test Process
LS Math/Secondary Level Assessments	10	260 items from 88 item field-tests forms
Life and Work/Life Skills/Citizenship/Secondary Level Assessments	22	47 items from 24 item field-tests forms
ECS/WLS Reading	14	265 items from 117 item field-tests forms
ECS/LS Listening	10	541 items from 87 item field-tests forms
ECS/WLS Math	**12**	**74 items from 106 item field-tests forms**
Life and Work Listening	6	39 items from 25 field-test forms

CASAS Item Bank

CASAS policy is to have a selection of reserve items across difficulty levels and content areas for each test series so that there is a continuous pipeline of items available. This reserve of items is available should specific items become compromised. Refer to item d3 for more information on the CASAS test security policy. These reserve items are also available if CASAS determines, through the continual analysis of psychometric properties, that items do not maintain the characteristics of reliability, validity, fairness, and sensitivity to demographic groups.

In order to keep this pipeline of items, CASAS field-tests a 40 to 50 percent surplus of items above the number of items originally needed for placement on the fixed item forms for a given series. Based on an analysis of the psychometric properties of field-test items, the items are grouped into three categories:

- Items that meet CASAS qualifications and are marked for inclusion on current forms
- Items the meet CASAS qualifications and are included in the item bank as reserve items

- Items that do not meet CASAS qualifications and are marked for archiving and possible future revision

When an entire test form or series is to be retired and replaced, the replenishment of the item bank requires the field-testing of large quantities of items to provide sufficient new items for the construction of the new test forms. The ECS Math tests are delivered via PPT and CBT, and CASAS uses an intact forms model to construct the test forms. This means that items were selected from the CASAS math item bank for construction of ten intact test forms which were individually packaged in the test file. Significant item field testing was required to develop items for this series, as described in this technical manual.

The CASAS math item bank for the ECS math series is organized to be a comprehensive source of information for the item and test developers. The database consists of easy-to-reference and up-to-date information on each item. Table c-2 describes the information elements contained in the item bank for the CASAS ECS math series.

Table c-2 Attributes of CASAS ECS Math Item Bank

General Item Information	Item identification number Item field-test form number and location/Item intact form and location Administration type Item text Correct answer
Item Statistics/Psychometric Properties	Field-test item information Historical item information Current p-value Rasch Unit (RIT difficulty index) Point bi-serial Index of Bias Fairness and sensitivity review comments Demographics and Sample Size Dataset used for analyses
Item Details	Item type Item referenced to CASAS Content Item referenced to CASAS Competencies Standards Word count Item type Word count of listening passage Gender reference Item enemies or clones Key words Item status version
Item Development History	Year written Item writer

Calibrate New Items and Add to the Item Pool

Poor-performing or problematic items are dropped, and the remaining items are then calibrated and then linked to the common CASAS measurement scale using the Rasch IRT model (if an anchor item performed poorly on the field test form, it is not used in the calibration process.). These newly calibrated items are then placed into the calibrated item pool. They are listed in the item database along with their statistical data, competency codes, and content standard codes. This process is further detailed under Item D of this document.

Construct Test Forms from the Item Pool

To construct a planned test form, the CASAS test development team selects items from the item pool to create a test that meets the design criteria (*Determine test development needs*). Factors considered include:

- item difficulty, by Rasch Unit (RIT)
- topical content
- skill content, in terms of the competencies and basic skills the item assesses
- item type – there are a number of math item types that address different math skills.
- item task and format – refers to how the information is presented and what the examinee needs to do to process it. Item task and format often relate to the skills an item addresses. A variety of item tasks and formats are represented on a test form to cover a broad range of math skills. Items are initially placed on the test form by difficulty: easier items first, followed by increasingly more difficult items. Adjustments are made to achieve variety and flow in topical and skill content, item task and format.

In selecting items for the test, achieving the desired coverage of skills is one consideration. Another is the scoring scale of the test: to fit into a test series of pre- and post-tests, a fairly specific scale score range is required. Items of different RITs may need to be substituted into the original selection to achieve the desired scale score range. Additionally, the proposed number of items on the test form may be increased or decreased in achieving the desired scale score range.

Parallel test forms are constructed simultaneously to achieve similarity in content and scale score range. The final forms are reviewed by the CASAS directors who check the coverage of competencies and basic skills, the scoring scale, the overall balance and flow, and the quality of the items themselves. When approved, the tests are assigned form numbers.

The performance of new test forms is monitored on a continual basis after implementation with various types of statistical analysis to ensure the tests are performing as intended, that the items are stable and not biased with subsequent adult populations being assessed. Many of these analyses are performed on an annual basis and include:

- classical item analyses
- fairness and sensitivity review including Differential Item Functioning (DIF) analyses and fairness and sensitivity item review panels
- reliability estimates
- validity studies

Item c1 – The nature of samples of examinees administered the test during pilot or field testing

(c1i) The number of examinees administered each item

Table c1i-1 contains information, by test form, for a group of examinees who were administered forms in the ECS Math series during the 2004-05 thru 2005-06 program years. Because of the differences in the number of learners at each educational functioning level and differences in number of forms administered by agencies providing adult education, the number of examinees administered each form varies. The years of education is the number of years of education completed as reported by the examinee to the test administrator.

Table c1i-1 ECS and WLS Math Examinee Information

ECS	No. of Items	Examinees	Gender		Ethnicity				Years of Education		Language	
Form	Math	N	Male	Female	White	Hispanic	Asian	Black	6 and below	7 and higher	English	Non English
11	24	839	501	316	110	456	10	228	145	611	441	398
12	24	802	417	375	131	420	206	16	129	599	467	335
13	31	11,956	9,622	2,310	3,531	4,979	257	2,861	403	11,257	9,671	2,285
14	31	6,893	4,171	2,696	1,650	3,030	266	1,674	355	6,254	4,975	1,918
213	30	355	94	261	16	310	1	25	0	355	146	209
214	30	653	209	444	37	548	4	58		653	313	340
15	31	8247	4,770	3,424	2,505	3,389	386	1,516	256	7,509	6,195	2,052
16	31	8,627	4,104	4,462	1,964	4,145	414	1,628	419	7,683	5,941	2,686
215	32	550	207	343	36	464	8	36	3	547	254	296
216	32	478	190	288	35	397	9	31	4	473	224	254
17	32	3,144	2,195	922	980	1,372	97	576	67	2,977	2,350	794
18	32	2,689	1,353	1,317	664	1,372	130	409	93	2,509	1,742	947
Total		45,233	27,833	17,158	11,659	20,882	1,788	9,058	1,874	41,427	32,719	12,514
%			61.5	37.9	25.8	46.2	4.0	20.0	4.1	91.6	72.3	27.7

(c1ii) How similar the sample or samples of examinees used to develop and evaluate the test were to the adult education population of interest to the NRS

Prior to the item field-testing and calibration process, all items were pilot-tested with both Adult Basic Education (ABE/ASE) and English as a Second Language (ESL) learners engaged in math classes. The items are then field-tested with both ABE/ASE and ESL learners engaged in math classes. The demographic characteristics of the sample are analyzed during the process to ensure that they are as representative as possible of the adult population of interest to the NRS. For comparison purposes, Tables c1ii-1 through c1ii-3 show the demographics of the adult educational population at the national and regional level during the 2005-06 program year.

Table c1ii-1 NRS Adult Education ABE and ASE Population – Gender Information

Gender	Male		Female	
	N	%	N	%
United States	680,976	50.5	666,687	49.5
Eastern Region	86,683	46.0	101,557	54.0
Midwestern Region	114,548	33.7	225,554	66.3
Southern Region	308,448	48.8	324,239	51.2
Western Region	149,106	56.9	113,032	43.1

Table c1ii-2 NRS Adult Education ABE and ASE Population – Ethnicity Information

Ethnicity	White		Hispanic		Black or African American		Asian	
	N	%	N	%	N	%	N	%
United States	567,229	42.1	290,684	21.6	418,098	31.0	27,657	2.1
Eastern Region	74,355	39.5	31,621	16.8	74,937	39.8	5,000	2.7
Midwestern Region	124,878	55.4	20,356	9.0	69,973	31.0	3,904	1.7
Southern Region	278,659	44.0	96,054	15.2	237,597	37.6	7,631	1.2
Western Region	89,244	34.0	106,055	40.5	35,168	13.4	11,054	4.2

(c1iii) The steps taken to ensure that the examinees were motivated while responding to the test

During the administration of field tests, CASAS provides detailed instructions to test administrators. Item 2 from the Field-test Administration Directions specifically states:

> *Explain to learners that we are making a new math test. Today we are going to find out how well the test works and if the questions are right for your level.*

Prior to administration of the test forms, administrators emphasize to the examinees the importance of doing their best on the test and answering the questions to the best of their ability, but not to guess at answers just to finish the test. Examinees are told the important role they are playing in the creation of a new test.

In addition, to help ensure that the test results are from examinees who were motivated while responding to the test, the actual calibration of items followed the recommendations of Wright (1968) and the experience of the Northwest Evaluation Association (Ingebo and Forster 1980) to include for item calibration purposes only those item response sets for examinees who had responded correctly to more than 20 percent and fewer than 90 percent of the items on the test. The exclusion of responses for this lower success range minimized the influence of including results for those who may have been guessing. One additional restriction eliminates results for those who do not have at least one correct answer on the last half of the test.

(c2i) The extent to which items or tasks on the test were reviewed for fairness and sensitivity

Bias and sensitivity reviews of all CASAS items are conducted to ensure that the performance of an examinee is based on construct-relevant factors and not construct-irrelevant factors or group classification characteristics such as gender, race, ethnicity, native language, or disability. The CASAS policy for bias and sensitivity review of all items and forms follows the guidelines outlined in the *ETS Fairness Review Guidelines* (Educational Testing Service, 2003). Also the *Standards for Educational and Psychological Testing* (AERA, APA, & NCME, 1999) and *Educational Measurement* (Brennan, 2006) were used in developing CASAS policy. CASAS has adopted this document as an outline for our policy for bias and sensitivity review. It also details specific guidelines to be used in CASAS bias and sensitivity reviews as recommended by CASAS psychometricans.

The majority of CASAS tests assess basic skills in an adult functional context. These tests are designed to assess a general skill, such as mathematical reasoning, reading comprehension, writing, listening comprehension, speaking, or problem solving that can be applied across competency areas such as consumer economics or employability.

General Guidelines for CASAS Fairness and Sensitivity Reviews (From ETS Fairness Review Guidelines)

1. **Equality of Treatment –** An important aspect of fairness is treating people with impartiality regardless of such characteristics as gender, race, ethnicity, or disability that are not relevant to the test.
2. **Familiarity with ETS Guidelines** – Fairness is addressed during the design and development phases of test creation. Content or images that would otherwise violate the guidelines are included in a test only if required for validity. All item writers review and are familiar with all guidelines for fairness prior to writing items and developing tests.
3. **External Contributions Outside CASAS –** There are contributions to tests from external people who represent relevant perspectives and diverse adult education groups. Representatives of various groups are included in test development committees to determine the knowledge, skills, and abilities to be tested.
4. **Preliminary Reviews** – Materials receive a preliminary fairness review before any substantive test publication work is done. This helps to recognize changes recommended by review panels at an early date and makes these changes less expensive and difficult to incorporate.
5. **Differential Item Functioning (DIF) –** The DIF procedure that CASAS has chosen to use is based on the work of Holland and Thayer (1988). The Mantel-Haenszel statistic compares the performance on an item for a "focal" group to that of a "reference" group matched in overall ability or proficiency. This matching controls for differences in abilities of these different groups. Example focal groups could be "females" or "Hispanic" and example reference groups could be "males" or "Caucasian," respectively. In other words, the Mantel-Haenszel DIF statistic is calculated to evaluate whether there is any statistical difference in item performance for groups of "females" and "males" that are matched for ability or proficiency. The DIF analyses are run on all CASAS items with the focal groups representing classifications of gender, ethnicity, and spoken language groups for which there is a large enough *N*. A statistically significant difference does not

automatically indicate than an item is biased. Rather, from these analyses, items are flagged for additional review. For CASAS, these subsequent reviews occur for any item with an absolute DIF value (Mantel-Haenzel statistic) greater than 1.5. CASAS chose this value based on ETS guidelines (Doran and Holland, 1993).

6. **Validation –** The strategies by which we collect evidence of fairness is called validation. Essentially, validation is the systematic collection of a body of evidence to evaluate intended interpretations and uses of test scores. Sources of evidence include test content, response processes, internal test structure, and relationships to other relevant variables. CASAS groups these aspects of validity evidence in two general clusters:
    a. Content validity – the examination of the test content to determine whether it covers a representative sample of what the test is intended to measure
    b. Construct validity – the examination of the test to ensure that it only measures the construct of interest.
7. **Score interpretation and use** – The appropriate interpretation and use of each CASAS test score is made available to test administrators, test users and score recipients.

Timeline for Fairness and Sensitivity Reviews

Consistent with best practice, items are reviewed for fairness and sensitivity throughout the item development process.

- Item writers review the items for fairness and sensitivity at the time of item development.
- Educators submit comments regarding fairness and sensitivity when they return completed field tests.
- The demographic characteristics of the field test examinees are reviewed to ensure that they are representative of the target population (i.e. the population that will be taking the test). If the demographic representation is not deemed adequate additional field tests are administered.
- DIF analysis is conducted on items based on field test results and ongoing psychometric analyses. A significant DIF statistic indicates that an item may be measuring something other than the construct of interest, but it is not proof of bias. Therefore, items that yield significant DIF statistics are not immediately deleted; instead, they are flagged for further in-depth review by SMEs and fairness and sensitivity panel members.
- A fairness and sensitivity panel is convened to review all items just prior to the time items are allocated to alternative test forms and prior to publishing. (Note: special attention is given to items with DIF statistics greater than 1.5
- Continuous test improvement and evaluation includes running DIF analyses and convening fairness and sensitivity panels. CASAS follows ETS and NRS Submission Guidelines by reviewing test items for fairness and sensitivity at least once every five years. (Note: special attention is given to items with DIF statistics greater than 1.5)

Guidelines for Fairness and Sensitivity – Item Writers and Educators

- All CASAS item writers receive Fairness and Sensitivity Training. This training consists of the review of example items and an in-depth review of six fairness review guidelines published by ETS and the standards outlined in chapter seven of *Standards for Educational and Psychological Testing*. In additional, items writers observe and participate on all Fairness and Sensitivity Review Panels conducted by CASAS.
- All new field-tested items are reviewed by educators in the field. Their comments are documented and reviewed by the CASAS team of item writers. The qualifications and experience of these educators is documented.

Guidelines for Selection of Fairness Review Panel Members

- Fairness and Sensitivity review panels are convened to:
    - Review items that are considered for inclusion on final test forms
    - Conduct periodic reviews of items on published CASAS tests
    - Conduct periodic reviews of items that have been flagged with DIF statistics greater than 1.5
- The fairness reviewers must have been trained in fairness review or have had the original training updated within the last five years. CASAS has developed a sensitivity and fairness training program that each panel member attends. This training lasts approximately two hours with a one hour of discussion with a CASAS trainer of the guidelines that each panel member should use in their review and one hour of self-study in which the panel members review and study the guidelines on an individual basis. This is in addition to other fairness and sensitivity training they have received. Demographic characteristics of the reviewers are considered as detailed below.
- The fairness reviewers have no stake in the test or other material being reviewed.
- The fairness reviewers are demographically diverse (age, ethnicity, gender).
    - The ethnicity of the panel members represents the populations being served.
    - The panel consists of a minimum of three members from each major ethnic group.
    - The gender of the panel members is diverse and not weighted too much to one gender
    - Different age groups are represented by the panel members

Guidelines for Fairness and Sensitivity Reviewers

The guidelines are intended to help ensure that only construct relevant factors affect examinees' scores. (Something that is construct-relevant is part of the knowledge, skills, abilities, or other characteristics a test is supposed to measure.) Test items that cause group differences because of construct-irrelevant factors do not meet standards for fairness and sensitivity.

The groups of primary concern for the Guidelines for Fairness and Sensitivity Reviewers, as outlined by ETS are defined by:

- Age

- Disability
- Ethnicity
- Gender
- National Origin
- Race
- Religion
- Sexual Orientation

The ETS Fairness Review Guidelines represent one consideration when evaluating validity evidence. Therefore, material required for construct-relevant measurement for a given intended use may be necessary even if it includes topics, ideas, attitudes, images, or other content that the guidelines would otherwise discourage. For example, a detailed description of the effects of a severe injury may be required to appropriately measure emergency medical personnel on a licensure test. However, such a description would likely not generalize to measuring reading ability in the average adult population because it would contain construct irrelevant factors that are unrelated to the intended use of the scores.

All CASAS fairness and sensitivity reviewers are given a brief background on the procedures followed to test for fairness and sensitivity during the design and development phases of the creation of the test.

Following are the six specific guidelines outlined by ETS. Below each guideline are examples of areas that each CASAS fairness reviewer considers when judging whether the specific guideline has been met. Below each guideline are examples of characteristics the items should have. Each CASAS fairness reviewer has access to the document *ETS Fairness Review Guidelines (2003)* to reference additional information about each guideline.

ETS Guideline 1. Treat people with respect in all test materials.

- Language and images show respect for all groups, unless required for validity (for example a history test might require material that normally would be out of compliance).
- Items emphasize that people in different groups function in a variety of societal roles.
- Items do not treat problems or beliefs of specific groups as humorous or inconsequential.
- Items do not state or imply that one group is superior to another or promote a certain opinion, value, or preference.
- Items do not assume that all examinees are citizens of the United States and have the same cultural background.
- Items avoid inappropriate underlying assumptions. For example, “The doctors and their wives attended the event.” (implies all doctors are men)

ETS Guideline 2. Minimize the effects of construct-irrelevant knowledge or skills.

- As per ETS, the following can cause problems with construct relevance and are included only if clearly construct relevant
    - Items avoid the use of charts, maps, graphs and the like if they are randomly chosen among many possible means of testing a point. In other words, if the examinee’s ability to correctly use the chart, map, or graph may create a new construct that the item is not meant to measure.

- Items avoid unnecessarily difficult words, figures of speech, idioms or synthetic structures. Also avoid:
  - Words or topics mainly associated with wealthier social class
  - Specialized legal, political words, scientific, and transportation words (affidavit, filibuster, vacuole)
  - Regionalisms
- Items do not require that the examinee needs specific knowledge about a religion to respond to an item.
- Items do not place the primary focus on military topics
- Items avoid that an examinee requires specific knowledge of culture in the United States (unless, as in previous guidelines, the item is designed to test such knowledge such as in a citizenship examination.

ETS Guideline 3. Avoid material that is unnecessarily controversial, inflammatory, offensive, or upsetting

- Items including unnecessarily inflammatory or upsetting material. Reasonably controversial material may be necessary for valid measurement even in skill tests. When controversial material is necessary for an item, use neutral language to discuss the issue.
- Items avoid, if possible, certain extremely controversial topics such as certain political issues, abortion, or abuse of people.
- Items treat certain topics with extreme care such as shocking accidents, illness, or natural disasters, death or dying, evolution, religion, slavery, suicide, violence, and suffering.
- Items use sensitivity regarding images that may be offensive to people from other countries.
- Items avoid using the test to promote a particular cause.

ETS Guideline 4. Use appropriate terminology to refer to people.

- Items do not attach unnecessary labels to people. If a person's membership in a group is not relevant to the item, do not mention this. If it is relevant, be certain to use the proper terminology to refer to the person/group. See the *ETS Fairness Review Guidelines* for a summary of the appropriate terminology for a wide variety of groups of persons.

ETS Guideline 5. Avoid stereotypes.

- As stated in the *ETS Fairness Review Guidelines*, a stereotype is defined as "a conventional, over-generalized, and oversimplified conception of the characteristics of a group of people. Stereotypes attribute characteristics to a group on the basis of age, disability, ethnicity, gender, national origin, race, religion, or sexual orientation. Stereotypes ignore differences among members of the group."

ETS Guideline 6. Represent diversity in depictions of people.

- Gender balance
- Racial and ethnic balance
- As mentioned under ETS Guideline #1, items emphasize that people in different groups function in a variety of societal roles. Depictions show diversity and balance.

Methodology of the CASAS Fairness and Sensitivity Reviews

- The CASAS fairness review is done with respect to the most recent version of the *ETS Fairness Review Guidelines*. The guidelines (see above) are reviewed with the fairness and sensitivity panel prior to beginning the review. The following documents are made available to all reviewers for reference:
    - *ETS Fairness Review Guidelines (2003)*
    - *ETS Standards for Quality and Fairness (2002)*
- The CASAS fairness reviewer has access to the test specifications and is aware of the characteristics of the test-taking population and the purpose of the test. The reviewers have access to all components of the test that an examinee would have, such as audiotapes (or scripts) and visual materials, in addition to the items. They are able to view items as the examinee would (same item placement).
- Fairness reviewers are provided a survey form to record their review results and recommendations. This survey form is designed so that reviewers can effectively record their review of each item and facilitates the aggregation of the results from each fairness and sensitivity reviewer. The survey form ensures that the panel member is responding to each of the guidelines listed above.
- Fairness reviewers first review the items individually noting any fairness and sensitivity issues with respect to the *ETS Fairness Review Guidelines*. The specific guideline that is violated is cited in each instance. Other comments or suggested actions recommended by the reviewers that are not violations of the Fairness Review Guidelines are noted and discussed but distinguished from violations of the Fairness Review Guidelines.
- To avoid reviewer fatigue, review panels are normally not assigned more than 175 review items. The panel process is usually completed within 2-3 weeks.
- After the individual review, all fairness reviewers meet to discuss the items that were identified as having any fairness or sensitivity issues. From these final group discussions, panel reviewers arrive at consensus regarding recommendations and issues with the reviewed items. Members from the CASAS item writing team and psychometrics team are present at this discussion.
- To protect the integrity of the results and the CASAS assessments, all testing related materials used by reviewers are returned and accounted for by CASAS. In addition, all panel members must sign a confidentiality agreement.
- Based on the results from the review panel, CASAS may decide to replace problematic items with new items covering the same content standards and of comparable difficulty.

Reporting Results from the CASAS Fairness Review Panel

- The methodology followed by the panel to conduct the review is summarized and documented by the leader of the study.
- All information on the panel members' demographic characteristics and qualifications (including any previous fairness and sensitivity training) is collected, aggregated as necessary, and summarized for reporting purposes.
- All conclusions (survey results) from the panel are summarized and aggregated for presentation in CASAS technical manuals.
- Changes to test forms or items based on the panel's recommendations are documented.

ECS Math Fairness and Sensitivity Review

As part of CASAS policy to continuously validate items and forms to ensure that they remain fair and sensitive to the intended testing population, in Fall 2008 a panel of key gender, ethnic, racial, ESL literacy and language specialists, to specifically analyze items from each test form with Mantel Haenzel Delta statistics greater than 1.5. A total 9 items were reviewed from the ECS Math series. The selection of panel members, review methodology, and reporting of results all followed the process outlined in this section. The panel consisted of 14 members. The demographic characteristics and background of the panel are presented in Tables c2i-1 to c2i-4.

Table c2i-1 Fairness and Sensitivity Panel – Gender

Gender	N	%
Female	7	50.0
Male	7	50.0
Total	14	100.0

Table c2i-2 Fairness and Sensitivity Panel – Age

Age	N	%
< 35	3	21.4
35-45	6	42.9
46-59	3	21.4
60+	2	14.3
Total	14	100.0

Table c2i-3 Fairness and Sensitivity Panel – Race or Ethnicity

Race or Ethnicity	N	%
Hispanic or Latino	4	28.6
White (Non Hispanic or Latino)	2	14.3
Asian	5	35.7
Black or African American	3	21.4
Total	14	100.0

Table c2i-4 Fairness and Sensitivity Panel – Panel Members and Background

Panelist #1	Lecturer – PhD in Education
Panelist #2	Retired Adult Education Administrator/Coordinator – BS Education, MS Educational Management
Panelist #3	Dean, San Francisco Community College – MA Bilingual Education
Panelist #4	Intake/Assessment Specialist – MA in TESOL
Panelist #5	Senior Forecast Analyst - MS in Social and Applied Economics, MBA in International Business
Panelist #6	Adult Education Coordinator, PhD
Panelist #7	Instructor
Panelist #8	Teacher – BA California Teaching Credential, MA Education
Panelist #9	Professor – California Community College Teaching Lifetime Credential – BA Communications
Panelist #10	Education Policy Analyst – ED.M. Education Policy and Management, B.A. Psychology
Panelist #11	Teacher/PDC Manager (CALPRO), MA
Panelist #12	Coordinator San Diego Office of Education – BA English Home Economics Masters in Education-Education Tech, Life Secondary Teaching Credential
Panelist #13	Director of Academic Development – M.A. TESOL
Panelist #14	Coordinator – BA Social Science, Masters in Education – Ed. Leadership, ESOL Certified

To illustrate the review process and criteria, a sample of a review form is presented in Table c2i-5. Overall, the review panel reported very few comments regarding potential violations of the six fairness guidelines (See *Guidelines for Fairness and Sensitivity Reviewers***)** and there was consensus to keep all items. As per CASAS guidelines, members from the CASAS item writing team and psychometrics team were present at the final panel discussion. Detailed notes were recorded of the panel's comments. When the tests were originally constructed, only those items that qualified for inclusion in the CASAS item bank were used in constructing the final test forms.

Based on the comments and recommendations of the panel review no additional items were selected for removal from the ECS Math test series. A summary of the reviewers comments are listed in Table c2i-6.

Table c2i-5 Sample Data Collection Form for Fairness and Sensitivity Panel Reviews

Test Item	Guidelines						Comments
	1. Treats people with respect in all test materials	*2. Minimizes the effects of construct-irrelevant knowledge or skills*	*3. Avoid material unnecessarily controversial, inflammatory, offensive, or upsetting*	*4. Uses appropriate terminology to refer to people*	*5. Avoids stereotypes*	*6. Represents diversity in depictions of people*	
1	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No	
2	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No	
3	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No	
4	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No	
5	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No	
6	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No	
7	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No	
8	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No	
9	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No	

Table c2i-6 Panel Member Comments from ECS Math and Overall Item Decision

Item	Comment	Consensus
14/31	Topic of oil supply	Consensus to keep item

The DIF procedure is based on the work of Holland and Thayer (1986). They adapted the Mantel-Haenszel statistic from medical research to compare the performance on an item of a "focal" group to that of a "reference" group matched in overall ability. In other words, the Mantel-Haenszel statistic is calculated to show how an examinee is responding to an item and if it is consistent with what their performance on the assessment as a whole would lead us to expect. This procedure provides a cumulative statistic of the log odds ratio of passing or failing an item for the two groups (focal and reference). This odds ratio is then converted to the Delta scale based on procedures developed at the Educational Testing Service (Holland and Thayer 1986).

The Delta value indicates the average amount by which examinees in a focal group found an item more difficult than did a reference group. Positive values on this scale indicate that the item favors the focal group, that is, an item with a positive value is differentially easier for the focal group. Similarly, an item with a negative Delta differentially favors the reference group.

Based on criteria developed by ETS (DeMauro, 1990), items having a Delta statistic less than an absolute value of 1.0 are used as needed to meet the content requirements of the test specifications. Items having a Delta statistic greater than 1.0 are subjected to review by content specialists to verify and determine possible reasons, if any, for the differential item functioning. Items having a Delta statistic greater than 1.5 are only used in a test if no other item from the required domain has a lower value and the item content is deemed critical to the assessment.

Tables c2i-7 through c2i-10 summarize the statistical DIF analyses by form. Items having an absolute Delta value of 1.5 or higher were subjected to a critical review by content specialists and only retained if the item content was essential to the assessment and no other item was available with a lower Delta statistic. Content specialists conducting the review included representatives from both the reference and focal groups.

Analysis by gender placed male as the reference group and female as the focal group. Ethnicity analyses were carried out with Anglo/white as the reference group and other ethnic groups as the focal group. Language analysis placed English as the reference group and speaking a language other than English as the focal group. DIF analysis was carried out for gender, ethnicity, and spoken language for the 2004-05 and 2005-06 program years.

Results from Table c2i-7 show that 47 items (13.1 percent of the total items) screened through DIF were identified and further reviewed by content specialists and psychometricans for gender bias or insensitivity, especially the two items (0.6 percent) with absolute values greater than 1.5.

Results from Table c2i-8 show that 18 items (5.0 percent of the total items) screened through DIF were identified and further reviewed by content specialists and psychometricans for Anglo-Hispanic ethnic bias or insensitivity, especially the item with an absolute value greater than 1.5.

Table c2i-7 Summary of Mantel-Haenszel Analysis for Gender

Math Form	Total Number of Items	Delta Difference Range: Test Items with Absolute Value Less than 1.0	Delta Difference Range: Test Items with Absolute Value Between 1.0 and 1.5	Delta Difference Range: Test Items with Absolute Value Greater than 1.5
11	24	18	6	0
12	24	22	2	0
13	31	28	3	0
14	31	29	2	0
213	30	28	2	0
214	30	27	3	0
15	31	28	3	0
16	31	29	2	0
215	32	25	7	0
216	32	28	4	0
17	32	25	5	2
18	32	26	6	0

Table c2i-8 Summary of Mantel-Haenszel Analysis for Ethnicity (Anglo – Hispanic)

Math Form	Total Number of Items	Delta Difference Range: Test Items with Absolute Value Less than 1.0	Delta Difference Range: Test Items with Absolute Value Between 1.0 and 1.5	Delta Difference Range: Test Items with Absolute Value Greater than 1.5
11	24	21	3	0
12	24	23	1	0
13	31	30	1	0
14	31	29	1	1
213	30	-	-	-
214	30	-	-	-
15	31	28	3	0
215	32	-	-	-
16	31	30	1	0
216	32	-	-	-
17	32	30	2	0
18	32	27	5	0

Results from Table c2i-9 show that, 14 items (3.9 percent of the total items) screened through DIF were identified and further reviewed by psychometricians and subject-matter experts for Anglo-African American ethnic bias or insensitivity especially the one item with an absolute value greater than 1.5.

Results from Table c2i-10 show that, 46 items (12.8 percent of the total items) screened were identified and further reviewed by psychometricians and subject-matter experts for other than English language bias or insensitivity, especially the 6 items (1.7 percent) with absolute values greater than 1.5.

Table c2i-9 Summary of Mantel-Haenszel Analysis for Ethnicity (Anglo-African American)

Math Form	Total Number of Items	Delta Difference Range		
		Test Items with Absolute Value Less than 1.0	Test Items with Absolute Value Between 1.0 and 1.5	Test Items with Absolute Value Greater than 1.5
11	24	23	1	0
12	24	24	0	0
13	31	28	3	0
14	31	30	1	0
213	30	-	-	-
214	30	-	-	-
15	31	30	1	0
16	31	30	1	0
215	32	-	-	-
216	32	-	-	-
17	32	30	1	1
18	32	27	5	0

Table c2i-10 Summary of Mantel-Haenszel Analysis for Spoken Language (English – Language Other Than English)

Math Form	Total Number of Items	Delta Difference Range		
		Test Items with Absolute Value Less than 1.0	Test Items with Absolute Value Between 1.0 and 1.5	Test Items with Absolute Value Greater than 1.5
11	24	16	5	3
12	24	14	9	1
13	31	30	1	0
14	31	29	1	1
213	30	25	5	0
214	30	25	5	0
15	31	28	3	0
16	31	31	0	0
215	32	29	3	0
216	32	27	5	0
17	32	30	2	0
18	32	30	1	1

Item c2 – The steps taken to ensure the quality of test items or tasks

(c2ii) The extent to which items or tasks on the test were screened for the adequacy of their psychometric properties

Both classical test theory and Rasch Item Response theory (IRT) measure the adequacy of the psychometric properties of the test forms. Rasch IRT is a measurement model designed to specify the relationship between observable examinee test performance on a set of items within a test form and the unobservable trait or ability measure assumed to underlie that performance. Classical Test Theory (CTT) is also employed to evaluate the difficulty of items, the correlation between item and total scores, the mean and standard deviation of test form scores, the standard error of measurement, and the reliability of the assessments.

Table c2ii-1 provides descriptive statistics for all ECS Math Test Forms. Included are the mean raw scores, standard deviations, mean p-values, and mean point bi-serial correlation coefficients. The alpha reliability coefficient, internal consistency reliability statistic Kuder-Richardson Formula 20 (KR-20), and standard error of measurement (SEM) are also reported. The p-value for each item shows the percentage of examinees who answered the item correctly. The point biserial correlates the performance of examinees on the item (correct or incorrect) with the total form score. A positive point biserial score for a particular item tells us that those examinees who scored higher on the overall exam were more likely to answer the item correctly. The alpha reliability coefficient for each scale is an index of the homogeneity of each scale. It can range from 0.0 to 1.0. This statistic is appropriate only for non-speeded scales designed to measure a single trait. The alpha value is usually considered to be a lower-bound estimate of the reliability of a scale (Crocker and Algina, 1984). The KR-20 coefficient measures how well a set of items (or variables) measures a single unidimensional latent construct. Higher values (closer to 1) indicate higher average inter-item correlations and provide evidence that the items are measuring the same underlying construct. The KR-20 reliability is equivalent to Cronbach's alpha reliability.

Table c2ii-1 Descriptive Statistics by Test Form

ECS Math Forms	No. of Items	N	Mean Raw Score	Standard Deviation	Mean P-Value	Mean Point Biserial	Alpha	KR-20
11	24	839	17.55	5.27	0.73	0.71	0.88	0.80
12	24	802	16.46	5.14	0.69	0.68	0.86	0.88
13	31	11,956	19.14	6.62	0.62	0.63	0.88	0.89
14	31	6,893	18.67	6.26	0.60	0.57	0.86	0.83
213	30	355	17.15	4.96	0.57	0.48	0.77	0.77
214	30	653	18.03	5.23	0.62	0.53	0.81	0.81
15	31	8247	19.70	6.02	0.64	0.58	0.85	0.85
16	31	8,627	19.18	6.04	0.62	0.58	0.85	0.83
215	32	550	16.94	6.66	0.53	0.56	0.86	0.87
216	32	478	17.52	6.27	0.55	0.54	0.85	0.85
17	32	3,144	13.66	6.19	0.43	0.54	0.84	0.85
18	32	2,689	15.01	6.55	0.47	0.56	0.86	0.82

Tables c2ii-2 through c2ii-5 provide descriptive statistics by form for a set of demographic characteristic subgroups. The descriptive statistics include mean raw score, standard deviation, mean p-value, mean point biserial, and alpha reliability coefficient. The demographic characteristic subgroups include gender, ethnicity, and language groups. Viewing the statistics in these groups provides evidence as to how different population subgroups are performing on the individual test forms.

Table c2ii-2 Descriptive Statistics by Demographic Characteristic Subgroups – Level A Forms

ECS Math Forms	No. of Items	Sub Groups	N	Mean Raw Score	Standard Deviation	Mean P-Value	Mean Point Biserial	Alpha
11 M	24	Male	501	17.51	5.40	0.73	0.72	0.88
		Female	316	17.56	5.06	0.73	0.69	0.87
		Hispanic	456	17.58	5.32	0.73	0.72	0.88
		White	110	18.26	5.27	0.76	0.75	0.89
		Black	228	17.03	5.21	0.71	0.70	0.87
		English Speaking	441	17.48	5.30	0.73	0.72	0.88
		Non English Speaking	398	17.62	5.24	0.71	0.73	0.88
12 M	24	Male	417	16.45	5.21	0.69	0.68	0.86
		Female	375	16.49	5.05	0.69	0.67	0.86
		Hispanic	420	16.77	4.98	0.70	0.66	0.85
		White	131	16.00	5.78	0.67	0.73	0.89
		Black	206	16.14	5.01	0.67	0.69	0.86
		English Speaking	467	16.14	5.43	0.67	0.71	0.88
		Non English Speaking	335	16.90	4.68	0.70	0.63	0.83

Table c2ii-3 Descriptive Statistics by Demographic Characteristic Subgroups – Level B Forms

ECS Math Forms	No. of Items	Sub Groups	N	Mean Raw Score	Standard Deviation	Mean P-Value	Mean Point Biserial	Alpha
13M	31	Male	9,622	19.14	6.71	0.62	0.63	0.89
		Female	2,310	19.16	6.20	0.62	0.60	0.87
		Hispanic	4,979	18.71	6.49	0.60	0.61	0.88
		White	3,531	21.15	6.45	0.68	0.67	0.89
		Black	2,861	17.32	6.41	0.56	0.58	0.87
		English Speaking	9,671	19.25	6.68	0.62	0.63	0.89
		Non English Speaking	2,285	18.66	6.33	0.60	0.59	0.87
14M	31	Male	4,171	18.52	6.35	0.60	0.58	0.86
		Female	2,696	18.90	6.12	0.61	0.56	0.85
		Hispanic	3,030	18.52	5.98	0.60	0.55	0.84
		White	1,650	20.11	6.37	0.65	0.61	0.87
		Black	1,674	17.44	6.20	0.56	0.56	0.85
		English Speaking	4,975	18.62	6.38	0.60	0.58	0.86
		Non English Speaking	1,918	18.78	5.93	0.61	0.55	0.84
213M	30	Male	94	18.55	5.58	0.62	0.57	0.84
		Female	261	16.64	4.61	0.56	0.44	0.73
		Hispanic	310	17.07	5.16	0.57	0.50	0.79
		English Speaking	146	17.69	4.82	0.59	0.48	0.77
		Non English Speaking	209	16.77	5.02	0.56	0.48	0.77
214M	30	Male	209	18.86	5.11	0.63	0.53	0.80
		Female	444	18.33	5.28	0.61	0.54	0.81
		Hispanic	548	18.55	5.31	0.62	0.54	0.82
		English Speaking	313	18.61	4.99	0.62	0.52	0.79
		Non English Speaking	340	18.40	5.44	0.61	0.55	0.82
		Hispanic	3,389	19.02	5.93	0.61	0.56	0.84
		White	2,505	21.55	5.64	0.70	0.60	0.85
		Black	1,581	18.15	5.96	0.59	0.55	0.84
		English Speaking	6,195	19.90	6.08	0.64	0.59	0.86
		Non English Speaking	2,052	19.09	5.80	0.62	0.55	0.83

Table c2ii-4 Descriptive Statistics by Demographic Characteristic Subgroups – Level C Forms

ECS Math Forms	No. of Items	Sub Groups	N	Mean Raw Score	Standard Deviation	Mean P-Value	Mean Point Biserial	Alpha
15M	31	Male	4,770	19.89	6.04	0.64	0.58	0.85
		Female	3,424	19.44	5.99	0.63	0.58	0.85
		Hispanic	3,389	19.02	5.93	0.61	0.56	0.84
		White	2,505	21.55	5.64	0.70	0.60	0.85
		Black	1,581	18.15	5.96	0.59	0.55	0.84
		English Speaking	6,195	19.90	6.08	0.64	0.59	0.86
		Non English Speaking	2,052	19.09	5.80	0.62	0.55	0.83
16M	31	Male	4,104	19.51	6.16	0.63	0.59	0.86
		Female	4,462	18.98	5.90	0.61	0.57	0.84
		Hispanic	4,145	18.82	5.85	0.61	0.56	0.84
		White	1,964	21.21	5.86	0.68	0.62	0.86
		Black	1,628	17.89	5.96	0.58	0.55	0.84
		English Speaking	5,941	19.23	6.11	0.62	0.59	0.86
		Non English Speaking	2,686	19.17	5.90	0.62	0.56	0.84
215M	32	Male	207	17.94	6.67	0.56	0.57	0.87
		Female	343	16.34	6.59	0.51	0.56	0.86
		Hispanic	464	16.81	6.65	0.53	0.56	0.86
		English Speaking	254	16.72	6.40	0.52	0.54	0.85
		Non English Speaking	296	17.14	6.87	0.54	0.58	0.87
216M	32	Male	190	18.26	6.81	0.57	0.59	0.87
		Female	288	17.02	5.83	0.53	0.51	0.82
		Hispanic	397	17.38	6.16	0.54	0.53	0.84
		English Speaking	224	17.41	6.39	0.54	0.55	0.85
		Non English Speaking	254	17.61	6.16	0.55	0.54	0.84

Table c2ii-5 Descriptive Statistics by Demographic Characteristic Subgroups – Level D Forms

ECS Math Forms	No. of Items	Sub Groups	N	Mean Raw Score	Standard Deviation	Mean P-Value	Mean Point Biserial	Alpha
17M	32	Male	2,195	14.37	6.49	0.45	0.56	0.86
		Female	922	11.97	5.04	0.37	0.46	0.77
		Hispanic	1,372	12.65	5.64	0.40	0.50	0.81
		White	980	15.27	6.36	0.48	0.55	0.85
		Black	576	13.05	6.28	0.41	0.55	0.85
		English Speaking	2,350	13.62	6.19	0.43	0.54	0.85
		Non English Speaking	794	13.75	6.17	0.43	0.54	0.84
18M	32	Male	1,353	17.045	6.753	0.533	0.58	0.871
		Female	1,317	13.002	5.637	0.406	0.501	0.812
		Hispanic	1,372	14.047	6.091	0.439	0.528	0.838
		White	664	17.22	6.733	0.538	0.593	0.875
		Black	409	14.623	6.696	0.457	0.57	0.866
		English Speaking	1,742	15.141	6.615	0.473	0.568	0.865
		Non English Speaking	947	14.767	6.434	0.461	0.554	0.857

Item c3 –The procedures used to assign items to

(c3i) Forms, for tests that are constructed prior to being administered to examinees

Tests constructed from the CASAS item bank of calibrated, statistically valid items are designed to certain test specifications that include requirements for function, skill level, content, and length. The function of a test – whether an appraisal, a progress test, or a certification test, for example – can determine the overall range of difficulty of the items included. The intended skill level targeted provides narrow parameter ranges for item difficulty. Test content focus, such as general life skills, general employment, workplace, or specific job area, provides direction for appropriate item selection. Within these broad content areas, specific competencies and content standards identified as priorities for the test being created provide further specificity for item selection. For example, a math item assessing competency 1.2.2 *Compare price, quality, and product information to determine the best buys for goods and services* might involve interpreting prices on a sale sign or ad in a store or on a flyer or in a newspaper, or looking at a price list on a Web page. In addition to the specific math skill involved in answering the question – for example:

6.1.2 *Subtract whole numbers*
6.1.5 *Perform multiple operations using whole numbers*
6.2.4 *Divide decimal fractions*
6.4.1 *Apply a percent*

The item might also address, depending on its particular content:

1.2.1 *Interpret advertisements, labels, charts, and price tags in selecting goods and services*
1.2.3 *Compute discounts*
1.2.4 *Interpret or compute unit pricing*
1.3.1 *Identify, compare and use methods for purchasing goods and services, including online purchasing*

Also entering into test item selection is the need for an appropriate variety of item content and item task or format requirements. Test length, determined by factors to include desired scoring scale to be derived, maximum length appropriate for completion, and range and depth of content to be included, is another factor in arriving at the final selection of items. Other considerations include, for example, whether the structure of a test series includes paired forms, in which case test forms of parallel content are designed.

(d) Maintenance. Documentation of how the test is maintained

Item d1 – How frequently new forms of the test are developed

After a test or test series has been implemented, situations may arise that call for the creation of new test forms.

In 2000 the Workforce Learning System (WLS) Math Assessments were published as a complement to the *ECS Math Assessments* for examinees at the CASAS B and C levels and the corresponding NRS levels: for ABE/ASE participants from Beginning Basic Education to High Intermediate Basic Education levels. The WLS tests are intended for use in workforce and employment-oriented training programs. The content of the tests is based on actual workplace materials and common situations found in a variety of job contexts appropriate for those who will be joining the workforce or are currently in the workforce. Parallel math tests forms for Level D, appropriate for NRS ASE levels, are currently being field-tested.

In another case, a need was expressed by implementing agencies for an appraisal/locater form with an accurate measurement range that extended high enough to place examinees directly into ASE level classes and level D testing. Thus, the Form 130 was created to supplement the Form 120. The same was done in creating a Form 230 Workplace Appraisal to supplement the Form 220.

In some instances a test form may be revised for a new version. In other instances, updating of formatting or minor content adjustments require a new edition of a test. In some cases a problematic item may need to be replaced and a new version created.

Development of a new math series is underway. The content of this series will be based on priority competencies and content standards determined by adult education math experts. The content will also be aligned to the College and Career Readiness Math standards for Adult Education and to the NRS Educational Functioning Levels for Adult Basic Education(ABE) and Adult Secondary Education (ASE).

Table d1-1 contains test form publishing information for the *ECS Math Assessments*. This table shows that periodically the *ECS Math Assessments* have been added to as needed based on both statistical information and feedback from teachers, test administrators, and examinees.

Table d1-1 ECS Math Test Publishing Information

ECS Test Form	Level	Type	Publish Date	Subsequent Editions	Computer Based Testing
11	A	Pre/Post	1988		2003
12	A	Pre/Post	1988		2003
13	B	Pre/Post	1988		2003
14	B	Pre/Post	1988		2003
213	B	Pre/Post	2003		2007
214	B	Pre/Post	2003		2007
15	C	Pre/Post	1988		2003
16	C	Pre/Post	1988		2003
215	C	Pre/Post	2003		2007
216	C	Pre/Post	2003		2007
17	D	Pre/Post	1997		2003
18	D	Pre/Post	1997		2003

Item d2 – The steps taken to ensure the comparability of scores across forms of the test

Item Response Theory and the comparability of scores across test forms and series

Item Response Theory (IRT) is a measurement model designed to specify the relationship between observable examinee test performance on a set of test items within a form and the unobservable trait or measured ability assumed to underlie that performance. IRT is the fundamental measurement model and procedures used to ensure comparability of scores across different forms and test series. Multiple banks of field-tested, calibrated items are used to develop specific CASAS assessment instruments and test series, including the *ECS Math Assessment* . Although the development of CASAS assessment instruments from the multiple item banks are based on many traditional psychometric procedures including the preparation of test specifications, sound item writing practices, and both the pilot and field-testing of items using classical item analysis procedures, the underlying theoretical measurement foundation is IRT.

The IRT model employed by CASAS for the development of the various item banks and the associated assessment instruments is the one parameter Rasch Model (1P-L). Under this IRT model, item difficulty is the single parameter used for estimating an examinee's ability. It can be expressed as:

$$P_i(\theta) \equiv P_i(X_i = 1 \mid \theta) = 1/1+exp[-(\theta - b_i)]$$

where X_i is the score for item *i*, with $X_i = 1$ for a correct response and $X_i = 0$ for an incorrect response. θ is the trait value for an examinee. The function $1/[1 + \exp(-t)] = [1 + \exp(-t)]^{-1}$ is a logistic function, with exp (-*t*) denoting *e* (the natural exponent, 2.718…) raised to the power –*t*. The higher the value of θ, the greater the examinee's ability. The parameter b_i, is commonly called the item difficulty, and it increases in value as items become more difficult (Yen and Fitzpatrick, 2006).

One major task in building and maintaining an item bank is to place all the items in a given learning modality, such as reading, listening, or mathematics, on a common scale. This involves calibrating the level of difficulty of each item within the content domain. An item bank can be developed by computing the item difficulty estimates from all examinees' responses to all items. However, establishing an item bank typically requires many more items than can be given in one test or far more than a single examinee can be realistically expected to answer in a reasonable amount of time. For each test series, such as ECS Math, CASAS chose to develop calibration forms having the same domain coverage with similar content and a range of difficulty. Expert teachers in the domain judged the item content similarity and range of difficulty to be appropriate for examinees participating in the initial calibration forms study. On all initial forms more than 95 percent of test examinees responded to all items.

The characteristic of the Rasch and other IRT models, which makes them appropriate for item banking, is that they separately measure an item difficulty calibration from the ability or proficiency of the group taking the item. This makes it possible to do vertical equating of scores from different test forms of increasing difficulty levels within a content domain. This allows for the measurement of achievement gains between the administrations of two different sets of items to the same examinee over a specified instructional time period. The use of an item banking model with Rasch IRT parameters for each item allows the development of a more general curriculum-based or content domain scale that measures specific content and competencies in a variety of adult employment preparation and workplace situations.

Results presented in other items of this submission, notably Item E for match of content and Item G for degree of consistency across different forms, provide evidence that parallel forms within the *ECS Math Assessments* are comparable in content and difficulty (as demonstrated in the raw to scale score correlations between parallel forms of ECS Math).

Initial Calibration and Linking of Forms

CASAS conducted the initial calibration of items in the fall of 1980 based on ten test forms. All forms contained basic life and employability skills items measured in a functional life and employability skills context. Since math in a functional context requires the ability to read, these items were initially included on the reading scale. A total of 4,115 examinees enrolled in adult basic education programs, including ESL and high school completion, participated in this first item calibration of 422 items.

In order to place all items on a single scale, sets of common items, or 8 – 10 linking items, were embedded among the ten forms. One calibration form was chosen as the "anchor" test to which all other tests were linked directly to establish the common content domain scale. The choice of an anchor test form was made following an earlier decision to focus on the development and selection of life skills competencies appropriate to a mid-range achievement level, that of intermediate ABE and ESL participants. This population was chosen because it had more experience in the classroom and with taking tests and was judged to be broadly representative of adult learners in general. The anchor form was also designed so that these examinees would respond successfully to more than 50 percent of the items. It was also decided to center the scale at this same mid-range achievement level and to convert the logit metric to a three-digit numerical scale by multiplying the logit scale by 10 and adding 200. This established the initial scaling of the CASAS tests with a mean of 200 and a standard deviation of 10 scale points.

The linking items on the various forms were used to adjust by scale parameter transformation the difficulties of non-linking items on each of the adjacent forms. This first series of calibration forms also included items appropriate for beginning and advanced levels of ABE and ESL.

The actual calibration of items followed the recommendations of Wright (1968) and the experience of the Northwest Evaluation Association (Ingebo and Forster 1980) to include only those item response sets for those who had responded correctly to more than 20 percent and fewer than 90 percent of the items on the test. The exclusion of responses from the lower success range minimized the influence of including results for those who may have been guessing. One additional restriction eliminated results for examinees who did not have at least one correct answer on the last half of the test.

Model Data Fit

During the calibration process, all items were examined to determine their level of model fit to the Rasch Model. Individual forms were independently subjected to a one-parameter analysis using BICAL as the Rasch item calibration program (Wright, B.D. and Mead, R.J., 1977). The two mean-square residual summary statistics, infit and outfit, were used to determine the degree of fit to the model. Although no hard-and-fast rules were used to identify misfitting items, those items with either infit or outfit values less than .7 or greater than 1.3 were reviewed by psychometricians and subject-matter experts and eliminated if not essential to the measurement of the competency statement.

Following this procedure, 863 student item response sets were then included for item calibration for the anchor form per content domain. This sample size was more than adequate to establish accurate calibrations. Research accomplished by the Northwest Evaluation Association indicated a sample size of 300 to be adequate for calibration purposes (NWEA, 1979). The remaining nine calibration forms were then scale to the base anchor form per content domain. All calibration forms met the minimum requirement of having at least 300 examinees respond to each item.

In addition to individual item responses on these item calibration forms, demographic and program descriptor information (including age, sex, ethnicity, primary language, number of years of school completed and program level enrollment) was collected for all learners in the initial item and form-linking calibrations.

In the spring of 1981, 16 additional item calibration forms were administered to 4,606 learners enrolled in Adult Basic Education, English as a Second Language, and high school completion programs. Items from the fall 1980 item calibrations were included in these forms to serve as linking items for the item

calibration process. Items from these two administrations were extensively analyzed, and those test items that met the assumptions of the Rasch Model were then included in the initial item banks. The BICAL program (Wright, B.D. and Mead, R.J. 1977) was used for the initial calibration of the CASAS item banks. Subsequent calibration programs used include RASCAL (Assessment Systems Corporation, 1989) and the Rasch program currently in use, WINSTEPS (Linacre, J.M. 2003). Each of these programs has been widely used in the psychometric research literature to calibrate educational test items.

Raw to scale score conversion

The parallel forms on the *ECS Math Assessments* are designed to perform identically for similar examinees taking the parallel forms of the tests. From the correlations of over .99, more than 98 percent of the variation can be accounted for when comparing raw and scale scores among parallel forms. This means a given raw score achieved on either parallel form (for example 15M or 16M) will translate to essentially the same scale score across the two test forms. Table d2-1 below illustrates the one-to-one relationship between raw score to scale conversions on parallel forms of the *ECS Math Assessments*. Because of this relationship the raw to scale score correlations of parallel forms will always approach 1.

Table d2-1 Raw to Scale Score Correlations of ECS Math Parallel Forms

Math Level	Correlation	Parallel Form Numbers
A	0.99	11 with 12
B	0.99	13 with 14
B	0.99	213 with 214
C	0.99	15 with 16
C	0.99	215 with 216
D	0.99	17 with 18

The following tables, d2-2 through d2-5, provide raw to scale score conversion charts along with the conditional standard error of measurement (CSEM) of the scale score for each measurement point for the ECS math forms. The CSEM provides an estimate of the average test score measurement error conditional on the proficiency estimate. This means that it provides an error estimate at each score point. Results presented in Tables d2-2 through d2-5 show that the CSEM is smallest with scores in the middle of the distribution. This is to be expected as Rasch IRT makes it clear that precision is not uniform across the entire range of test scores. Typically there is more information about learners with scores in the middle of the score distribution and the scores are more reliable. Conversely scores at the edges of the range of the test generally have a higher CSEM and provide less reliable information. Tables d2-2 through d2-5 signify scores in the accurate range with a vertical bar. For example, for Form 12 the lowest accurate score is 175 and the highest accurate score is 204. Scores that have a corresponding CSEM of 5.6 or greater have scale estimates that are above the accurate range and are signified at the high end with a diamond symbol (♦).

Table d2-2 Raw to Scale Score Conversion with CSEM – Level A Forms

Form 11

Raw Score	Scale Score	Std Error
1	156	10.3
2	164	7.6
3	169	6.4
4	172	5.7
5	175	5.2
6	178	4.9
7	180	4.7
8	182	4.5
9	184	4.4
10	186	4.4
11	188	4.3
12	190	4.3
13	192	4.3
14	194	4.3
15	196	4.4
16	198	4.5
17	200	4.7
18	202	4.9
19	204	5.2
20	205♦	5.6
21	206♦	6.3
22	208♦	7.5
23	209♦	10.3
24	210♦	

Form 12

Raw Score	Scale Score	Std Error
1	156	10.3
2	164	7.6
3	168	6.4
4	172	5.7
5	175	5.2
6	178	4.9
7	180	4.7
8	182	4.6
9	184	4.4
10	186	4.4
11	188	4.3
12	190	4.3
13	192	4.3
14	194	4.4
15	195	4.4
16	197	4.5
17	200	4.7
18	202	4.9
19	204	5.2
20	206♦	5.6
21	207♦	6.3
22	209♦	7.5
23	210♦	10.3
24	212♦	

Table d2-3 Raw to Scale Score Conversion with CSEM – Level B Forms

Form 13			Form 14			Form 213			Form 214		
Raw Score	Scale Score	Std Error	Raw Score	Scaled Score	Std Error	Raw Score	Scale Score	Std Error	Raw Score	Scaled Score	Std Error
1	171	10.2	1	171	10.2	1	170	10.3	1	-	10.3
2	178	7.4	2	178	7.4	2	178	7.5	2	-	7.5
3	183	6.2	3	182	6.2	3	182	6.2	3	-	6.3
4	186	5.5	4	186	5.5	4	186	5.6	4	-	5.6
5	189	5.0	5	189	5.0	5	188	5.2	5	188	5.2
6	191	4.7	6	191	4.7	6	191	4.8	6	191	4.9
7	193	4.5	7	193	4.5	7	193	4.6	7	193	4.6
8	195	4.3	8	195	4.3	8	195	4.4	8	195	4.4
9	197	4.1	9	197	4.1	9	197	4.3	9	197	4.3
10	199	4.0	10	198	4.0	10	199	4.2	10	199	4.2
11	200	3.9	11	200	3.9	11	201	4.1	11	201	4.1
12	202	3.9	12	202	3.9	12	202	4.1	12	202	4.0
13	203	3.8	13	203	3.8	13	204	4.0	13	204	4.0
14	205	3.8	14	204	3.8	14	206	4.0	14	206	4.0
15	206	3.8	15	206	3.8	15	207	4.0	15	207	4.0
16	208	3.8	16	207	3.8	16	209	4.0	16	209	4.0
17	209	3.8	17	209	3.8	17	210	4.0	17	210	4.0
18	210	3.8	18	210	3.8	18	212	4.0	18	212	4.0
19	212	3.8	19	212	3.9	19	214	4.1	19	214	4.1
20	213	3.9	20	213	3.9	20	215	4.2	20	215	4.2
21	215	4.0	21	215	4.0	21	217	4.3	21	217	4.3
22	216	4.1	22	216	4.1	22	219	4.4	22	219	4.4
23	218	4.2	23	218	4.3	23	221	4.6	23	221	4.6
24	220	4.4	24	220	4.4	24	223	4.8	24	223	4.8
25	222	4.7	25	222	4.7	25	226	5.1	25	226	5.1
26	224	5.0	26	224	5.0	26	227♦	5.6	26	227♦	5.6
27	227	5.5	27	227	5.5	27	228♦	6.2	27	228♦	6.2
28	229♦	6.2	28	228♦	6.2	28	230♦	7.5	28	230♦	7.4
29	230♦	7.4	29	230♦	7.4	29	232♦	8.8	29	232♦	8.7
30	232♦	10.2	30	232♦	10.2	30	233♦		30	233♦	
31	234♦		31	234♦							

Table d2-4 Raw to Scale Score Conversion with CSEM – Level C Forms

Form 15			Form 16			Form 215			Form 216		
Raw Score	Scaled Score	Std Error	Raw Score	Scaled Score	Std Error	Raw Score	Scaled Score	Std Error	Raw Score	Scaled Score	Std Error
1	185	10.2	1	185	10.2	1	-	10.2	1	-	10.2
2	192	7.4	2	192	7.4	2	-	7.5	2	-	7.5
3	197	6.2	3	197	6.2	3	-	6.2	3	-	6.2
4	200	5.5	4	200	5.5	4	200	5.4	4	200	5.4
5	203	5.0	5	203	5.0	5	203	5.0	5	203	5.0
6	205	4.7	6	205	4.7	6	205	4.7	6	205	4.7
7	207	4.4	7	207	4.4	7	207	4.4	7	207	4.4
8	209	4.3	8	209	4.2	8	209	4.2	8	209	4.2
9	211	4.1	9	211	4.1	9	211	4.1	9	211	4.1
10	212	4.0	10	212	4.0	10	212	4.0	10	212	4.0
11	214	3.9	11	214	3.9	11	214	3.9	11	214	3.9
12	215	3.9	12	215	3.8	12	216	3.8	12	216	3.8
13	217	3.8	13	217	3.8	13	217	3.8	13	217	3.8
14	218	3.8	14	218	3.8	14	218	3.8	14	218	3.8
15	220	3.8	15	220	3.8	15	220	3.7	15	220	3.7
16	221	3.8	16	221	3.8	16	221	3.7	16	221	3.7
17	223	3.8	17	222	3.8	17	222	3.7	17	222	3.7
18	224	3.8	18	224	3.8	18	224	3.8	18	224	3.8
19	226	3.9	19	225	3.9	19	225	3.8	19	225	3.8
20	227	3.9	20	227	3.9	20	227	3.8	20	227	3.8
21	229	4.0	21	228	4.0	21	228	3.9	21	228	3.9
22	230	4.1	22	230	4.1	22	230	4.0	22	230	4.0
23	232	4.3	23	232	4.3	23	232	4.1	23	232	4.1
24	234	4.5	24	234	4.6	24	233	4.3	24	233	4.3
25	236	4.7	25	236	4.7	25	235	4.5	25	235	4.4
26	238	5.0	26	238	5.0	26	237	4.7	26	237	4.7
27	241	5.5	27	241	5.5	27	240	5.0	27	240	5.0
28	242♦	6.2	28	242♦	6.2	28	242	5.5	28	242	5.5
29	244♦	7.4	29	244♦	7.4	29	244♦	6.2	29	244♦	6.2
30	246♦	10.2	30	246♦	10.2	30	246♦	7.4	30	246♦	7.4
31	248♦		31	248♦		31	248♦	8.7	31	248♦	8.7
						32	250♦	8.7	32	250♦	

Table d2-5 Raw to Scale Score Conversion with CSEM – Level D Forms

Form 17			Form 18		
Raw Score	Scaled Score	Std Error	Raw Score	Scaled Score	Std Error
1	196	10.5	1	197	10.3
2	203	7.6	2	204	7.6
3	208	6.4	3	209	6.3
4	212	5.7	4	212	5.6
5	215	5.2	5	215	5.1
6	217	4.9	6	218	4.8
7	220	4.6	7	220	4.6
8	222	4.4	8	222	4.4
9	224	4.3	9	224	4.2
10	225	4.1	10	225	4.1
11	227	4.0	11	227	4.0
12	229	4.0	12	229	4.0
13	230	3.9	13	230	3.9
14	232	3.9	14	232	3.9
15	233	3.9	15	233	3.9
16	235	3.9	16	235	3.8
17	236	3.9	17	236	3.9
18	238	3.9	18	238	3.9
19	239	3.9	19	239	3.9
20	241	4.0	20	241	4.0
21	242	4.0	21	242	4.0
22	244	4.1	22	244	4.1
23	246	4.2	23	246	4.3
24	248	4.4	24	248	4.4
25	250	4.6	25	250	4.6
26	252	4.8	26	252	4.8
27	254	5.1	27	254	5.2
28	256♦	5.6	28	256♦	5.6
29	258♦	6.3	29	258♦	6.3
30	261♦	7.5	30	261♦	7.6
31	264♦	8.7	31	264♦	8.8
32	267♦		32	267♦	

Ongoing Item Bank Expansion

All new test items placed into the existing content domain banks follow a similar path that includes initial review, clinical tryout with a small sample of examinees, additional revisions as necessary, placement into field-test/calibration forms administered to a minimum of 300 examinees, calculation of classical item statistics (p-value, point bi-serial correlation, estimated discrimination, lower asymptote, and DIF statistics), and Rasch IRT difficulty and fit statistics. Field-test/calibration forms included between eight and ten linking items selected from the content domain bank for their appropriateness with respect to the content of the proposed items and their IRT difficulty across the ability range of examinees who are intended to respond to the item. Also, as in the initial bank development, the fit of items to the one-parameter model is examined by computing both infit and outfit model fit values. Items having fit values falling below .7 or above 1.3 are subject to review by psychometricians and subject matter experts and possible rewrite or exclusion from the item content domain bank. Please refer to Item c3i for a detailed description of the procedures used to assign items to forms.

Stability of Item Parameter Estimates

As part of periodic psychometric maintenance for assessment programs, it is important to evaluate the stability of item parameter estimates over time (Wendler & Walker, 2006). If item characteristics substantively change, it raises a potential threat to the validity of intended score use and interpretations. When these changes influence decisions about items or the scale, it is often called item or scale drift (Yen & Fitzpatrick, 2006). To evaluate item drift, we conduct two types of analyses.

First, we evaluate classical test statistics from items selected from different years. In Table d2-6, we selected forms from 2000-01 to compare with the same forms that were administered in 2005-06. For example, from Table d2-6 data we see that the average scores for ECS Form 11 in 2000-01 remained almost the same when compared to the average score in 2005-06. The item difficulty (mean P-value) also remained steady over the 5 year period, suggesting that the average items were functioning at the same difficulty level for students in 2000-01 and 2005-06. However, these summary statistics only serve as a starting point for item level analyses to evaluate whether these observed data demonstrate any systematic patterns of drift across items.

Table d2-6 Comparability of Descriptive Statistics for ECS Math Forms

Descriptive Statistics	11 Math		12 Math	
	2000-01	2005-06	2000-01	2005-06
N of Items	24	24	24	24
N of Examinees	814	966	370	371
Mean	18.29	18.39	17	17.01
Variance	27.499	28.87	32.741	21.326
Std. Dev.	5.244	5.373	5.722	4.618
Skew	-0.978	-0.98	-0.637	-0.542
Kurtosis	-0.083	-0.154	-0.842	-0.769
Minimum	5	5	5	7
Maximum	24	24	24	23
Median	20	20	19	18
Alpha	0.885	0.895	0.899	0.829
SEM	1.778	1.737	1.817	1.909
Mean P	0.762	0.766	0.708	0.709
Mean Item-Tot.	0.525	0.543	0.552	0.445
Mean Biserial	0.74	0.772	0.765	0.622
Max Score (Low)	16	16	13	14
N (Low Group)	232	285	101	102
Min Score (High)	22	22	22	21
N (High Group)	294	386	104	116

Descriptive Statistics	13 Math		14 Math	
	2000-01	2005-06	2000-01	2005-06
N of Items	31	31	31	31
N of Examinees	3420	11956	1271	4160
Mean	17.88	19.141	17.585	18.625
Variance	37.398	43.783	31.601	40.909
Std. Dev.	6.115	6.617	5.621	6.396
Skew	-0.245	-0.353	-0.322	-0.245
Kurtosis	-0.837	-0.892	-0.722	-0.836
Minimum	4	4	4	4
Maximum	30	30	30	30
Median	19	20	18	19
Alpha	0.853	0.883	0.812	0.864
SEM	2.342	2.268	2.438	2.362
Mean P	0.577	0.617	0.567	0.601
Mean Item-Tot.	0.429	0.47	0.389	0.443
Mean Biserial	0.566	0.625	0.51	0.581
Max Score (Low)	14	15	14	14
N (Low Group)	1042	3658	386	1151
Min Score (High)	22	24	22	23
N (High Group)	1101	3745	369	1322

Descriptive Statistics	15 Math		16 Math	
	2000-01	2005-06	2000-01	2005-06
N of Items	31	31	31	31
N of Examinees	3870	8247	1454	4756
Mean	19.634	19.698	19.047	18.953
Variance	34.965	36.234	30.05	35.581
Std. Dev.	5.913	6.019	5.482	5.965
Skew	-0.548	-0.524	-0.551	-0.348
Kurtosis	-0.435	-0.484	-0.503	-0.665
Minimum	4	4	4	4
Maximum	30	30	27	30
Median	21	21	20	20
Alpha	0.847	0.852	0.809	0.846
SEM	2.315	2.312	2.393	2.343
Mean P	0.633	0.635	0.614	0.611
Mean Item-Tot.	0.424	0.432	0.393	0.425
Mean Biserial	0.57	0.579	0.529	0.571
Max Score (Low)	16	16	16	15
N (Low Group)	1076	2327	440	1379
Min Score (High)	24	24	23	23
N (High Group)	1148	2574	467	1516

Descriptive Statistics	17 Math		18 Math	
	2000-01	2005-06	2000-01	2005-06
N of Items	32	32	32	32
N of Examinees	837	3144	422	1337
Mean	14.565	13.656	14.704	14.637
Variance	34.423	38.268	33.479	44.094
Std. Dev.	5.867	6.186	5.786	6.64
Skew	0.562	0.781	0.283	0.526
Kurtosis	-0.319	-0.119	-0.827	-0.66
Minimum	5	5	5	5
Maximum	31	31	27	31
Median	14	12	14	13
Alpha	0.829	0.844	0.817	0.866
SEM	2.43	2.445	2.478	2.428
Mean P	0.455	0.427	0.459	0.457
Mean Item-Tot.	0.395	0.412	0.383	0.439
Mean Biserial	0.52	0.538	0.499	0.571
Max Score (Low)	10	9	10	9
N (Low Group)	248	963	122	366
Min Score (High)	18	17	19	19
N (High Group)	242	898	116	381

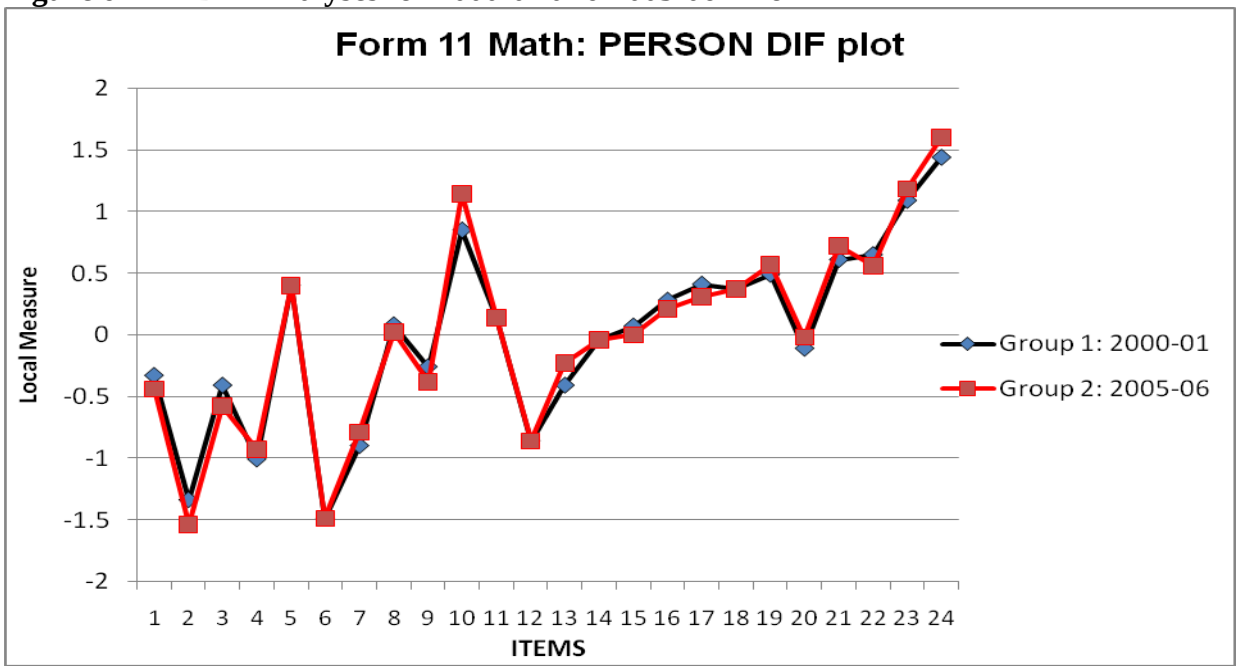
Descriptive Statistics	213 Math		214 Math	
	2005-06	2007-08	2000-01	2005-06
N of Items	30	30	30	30
N of Examinees	355	334	653	273
Mean	17.146	17.347	18.502	17.835
Variance	24.57	27.724	27.35	21.713
Std. Dev.	4.957	5.265	5.23	4.66
Skew	-0.245	-0.221	-0.288	-0.243
Kurtosis	-0.481	-0.688	-0.554	-0.587
Minimum	5	5	5	6
Maximum	29	28	29	27
Median	17	18	19	18
Alpha	0.772	0.798	0.809	0.753
SEM	2.369	2.366	2.288	2.318
Mean P	0.572	0.578	0.617	0.595
Mean Item-Tot.	0.362	0.383	0.391	0.348
Mean Biserial	0.481	0.507	0.532	0.471
Max Score (Low)	14	14	15	15
N (Low Group)	108	104	188	82
Min Score (High)	20	21	22	21
N (High Group)	119	105	209	88

Descriptive Statistics	215 Math		216 Math	
	2005-06	2007-08	2000-01	2005-06
N of Items	32	32	32	32
N of Examinees	550	840	478	734
Mean	16.944	16.3	17.517	16.018
Variance	44.359	37.734	39.3	33.535
Std. Dev.	6.66	6.143	6.269	5.791
Skew	0.169	0.235	0.048	0.419
Kurtosis	-0.88	-0.76	-0.783	-0.686
Minimum	4	4	4	7
Maximum	31	31	31	31
Median	16	16	17	15
Alpha	0.863	0.831	0.846	0.808
SEM	2.463	2.522	2.46	2.54
Mean P	0.529	0.509	0.547	0.501
Mean Item-Tot.	0.436	0.4	0.416	0.378
Mean Biserial	0.563	0.515	0.541	0.488
Max Score (Low)	12	12	13	12
N (Low Group)	163	267	136	249
Min Score (High)	21	20	22	20
N (High Group)	163	256	140	203

Classical test theory statistics are sample dependent, therefore a second level of analyses occurs at the item level and relies on item response theory (IRT) principles to control for different abilities. Using IRT, specifically the Rasch model, differential item functioning (DIF) analyses are conducted using assessment forms from different years as the reference and focal groups. Data for DIF analysis is run in the Winsteps software. Figures d2-1 thru d2-12 show the results of these analyses for the comparison of 2000-01 and 2005-06 item parameters. From these charts it appears that there are no systematic shifts in item difficulty from 2000-01 to 2005-06. There were no items from the math forms 11-18 and 213-216 that shifted more than .4 logits or higher.

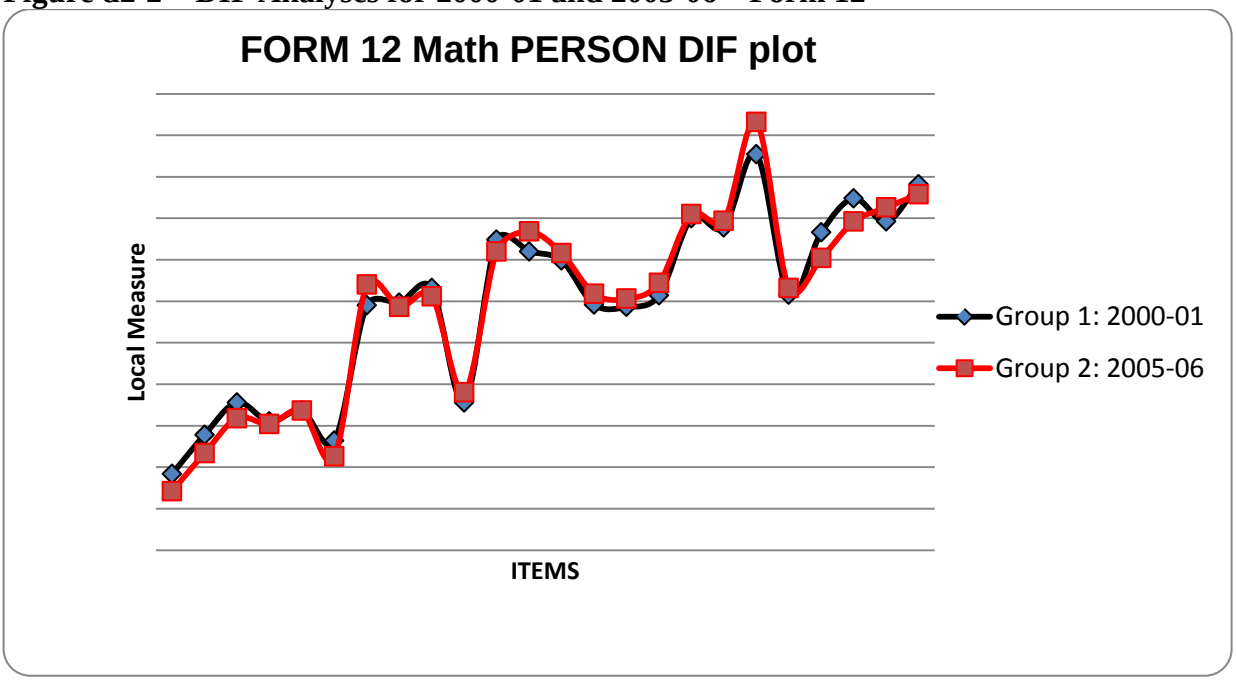
In Figure d2-1 item parameters for ECS Form 11 are compared on the logit scale based on the year of administration. There are some items that scaled to be slightly easier in 2005-06 than 2000-01 (e.g., Items 1, 2,3,17, and 9). There were also items that were easier in 2000-01 than in 2005-06 (e.g., Items 4, 7, 10, 13, 21, and 24). Finally, there were items that had almost identical parameter estimates (e.g., Items 5, 6, 8, 11, 12, 14, 15, 16, 18, 19, 20, 22 and 23).

Figure d2-1 DIF Analyses for 2000-01 and 2005-06 – Form 11



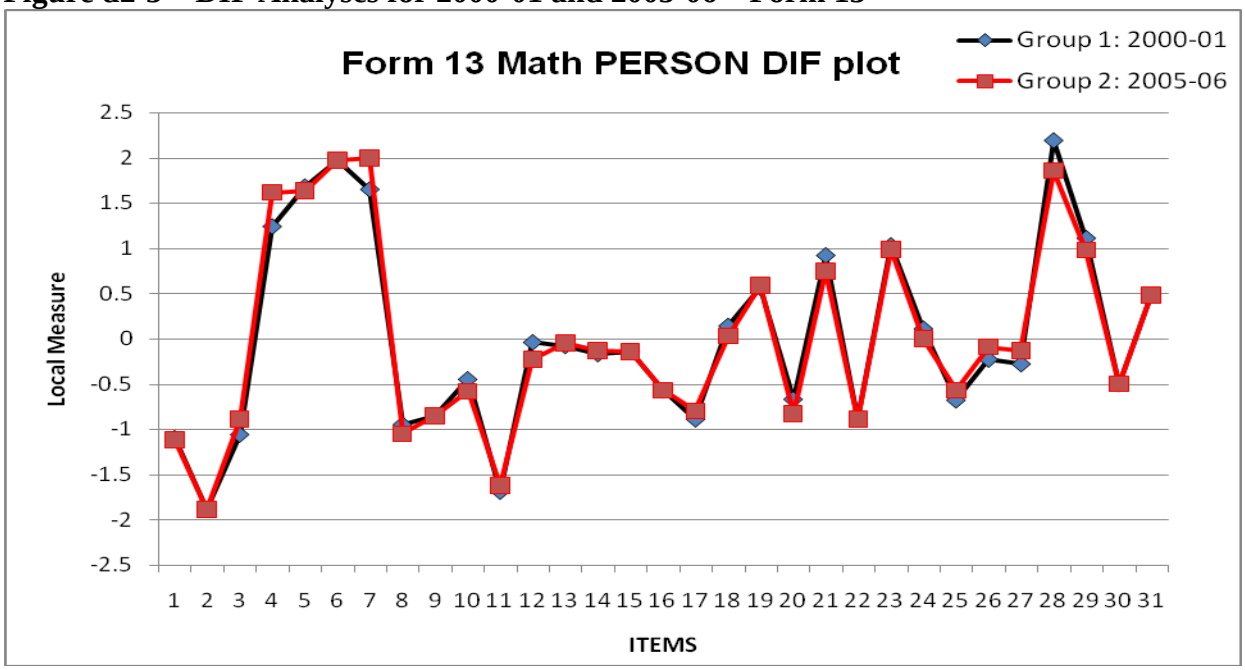
Form 12 (Figure d2-2) had 15 items with almost identical parameter estimates (e.g., Items 4, 5, 8, 9, 10, 11, 13-18, 19, 20, and 24). Evaluating these graphical illustrations also helps to highlight where additional exploration may be needed. For example, Item 19 shifted to be almost half a logit (.39) easier in 2005-06 than 2000-01.

Figure d2-2 DIF Analyses for 2000-01 and 2005-06 – Form 12



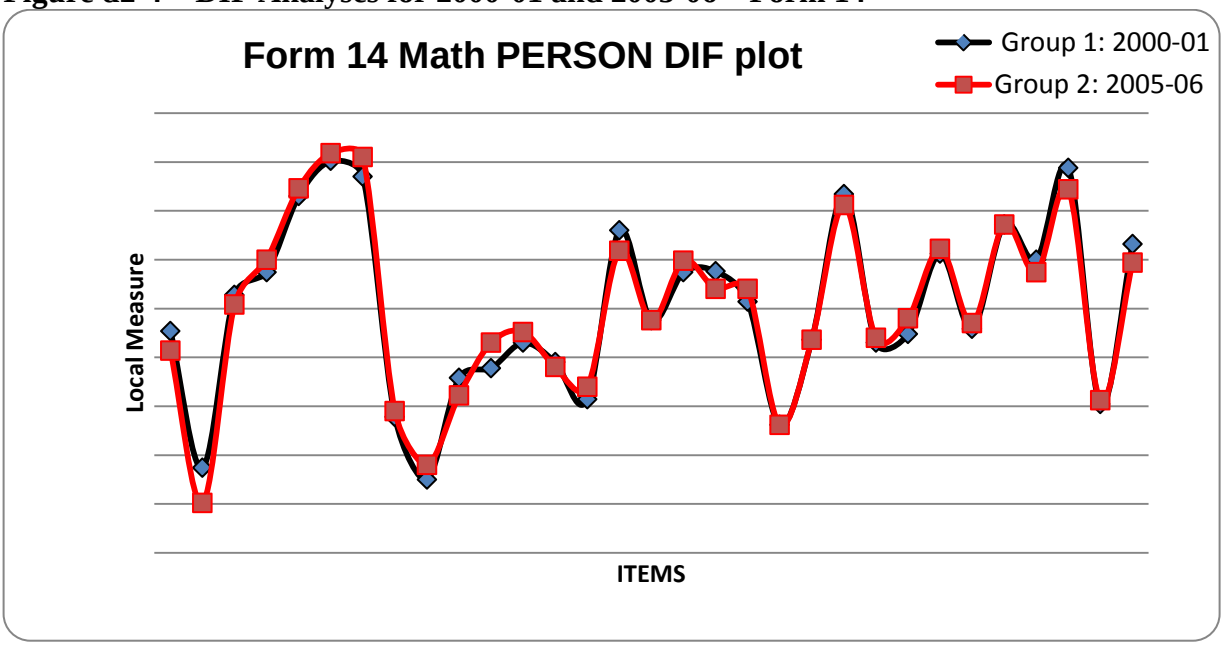
Form 13 shows (Figure d2-3) some items that scaled to be slightly easier in 2005-06 than 2000-01 (e.g., Items 3, 12, 18, 20, 21, and 28). However, there were also items that were easier in 2000-01 than in 2005-06 (e.g., Items 10, 21, 25, 26, and 27). Finally, there were items that had almost identical parameter estimates (e.g., Items 1, 2, 5, 6, 8, 9, 11, 13 -19, 22-25, 30, and 31).

Figure d2-3 DIF Analyses for 2000-01 and 2005-06 – Form 13



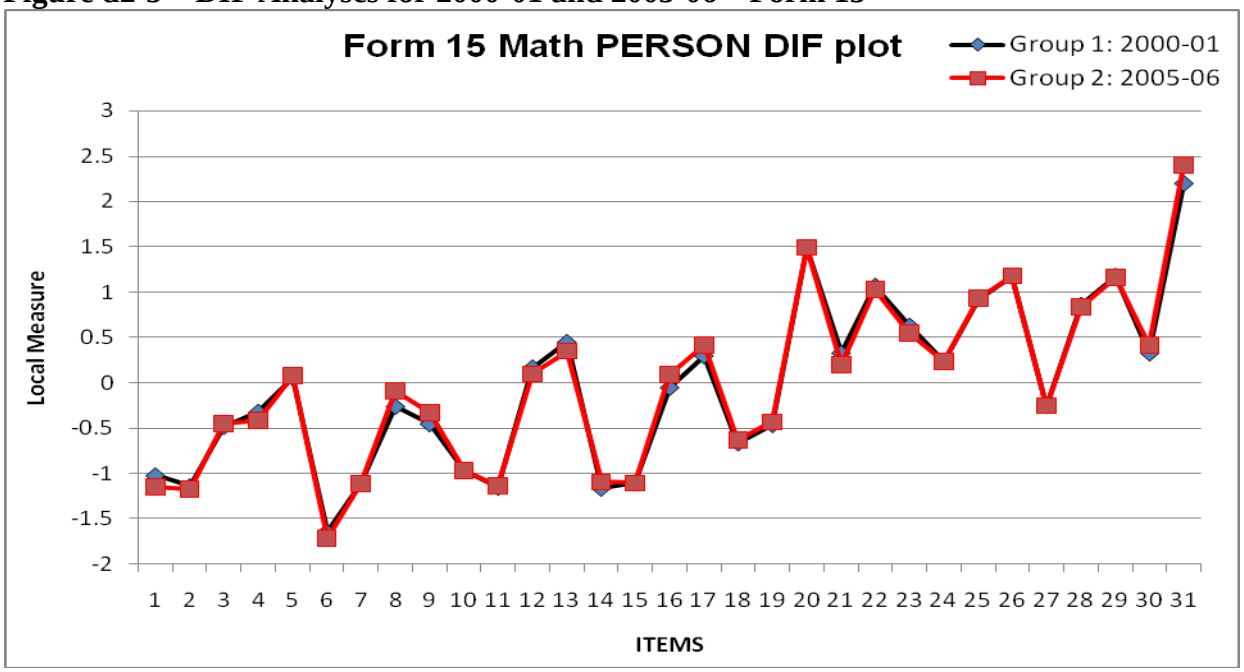
On Form 14 (Figure d2-4), items 1, 15, 29, and 31 scaled to be slightly easier in 2005-06 than 2000-01. Items 9, 11, 12, and 14 were easier in 2000-01 than in 2005-06. Items 5, 6, 8, 13, 16, 20, 21, 23, 25, and 26 had almost identical parameter estimates. Item 2 shifted almost half a logit easier in 2005-06 than 2000-01.

Figure d2-4 DIF Analyses for 2000-01 and 2005-06 – Form 14



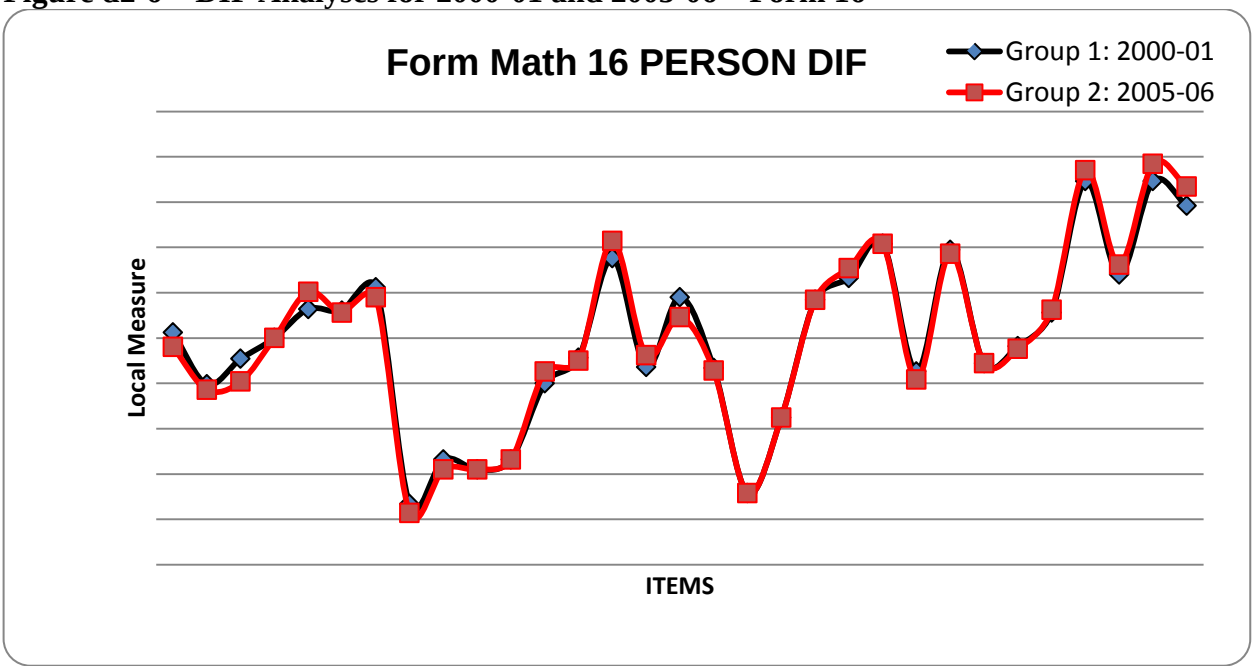
On Form 15 (Figure d2-5), 24 out of the 31 items had almost identical parameter estimates. Only one item, item 8, shifted .17 logit easier.

Figure d2-5 DIF Analyses for 2000-01 and 2005-06 – Form 15



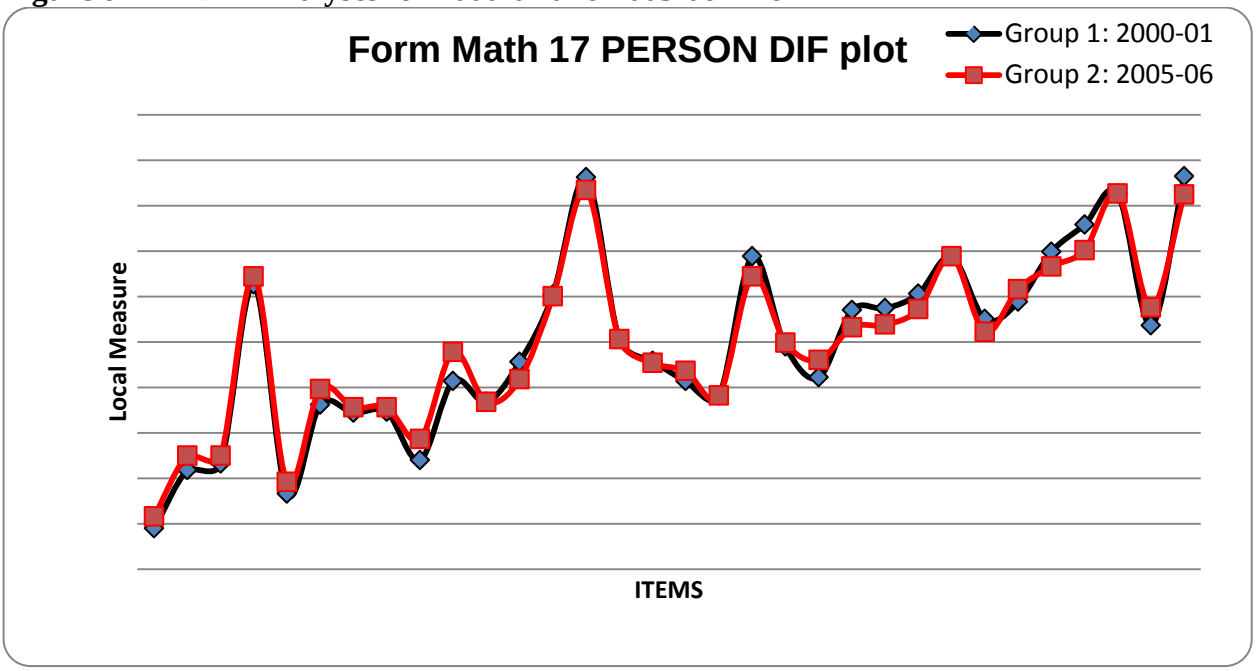
Similar to Form 15 (Figure d2-6), on Form 16 (Chart 2.1.7) 21 out of the 31 items had almost identical parameter estimates. Only item 3 shifted .25 logit easier in 2005-06.

Figure d2-6 DIF Analyses for 2000-01 and 2005-06 – Form 16



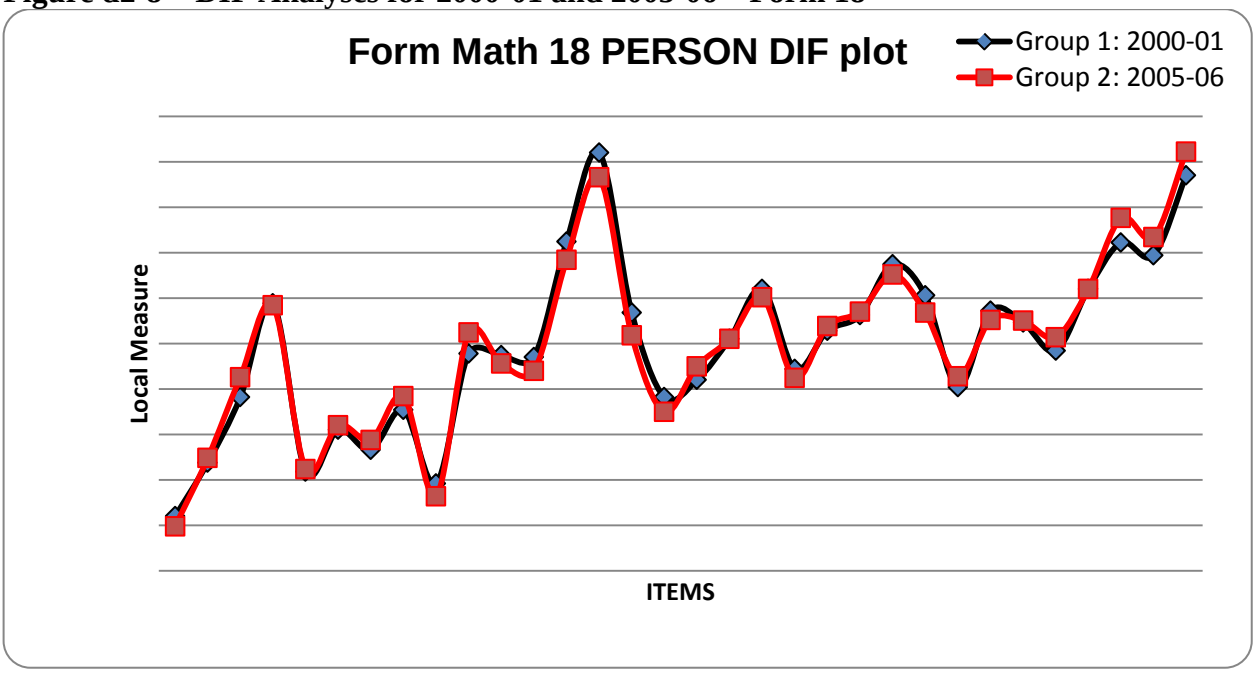
On Form 17 (Figure d2-7), items 1, 2, 12, 14, 19, 22 – 24, 26, 28, 29, and 32 scaled to be slightly easier in 2005-06 than 2000-01. Items 5, 6, 9, 10, 21, 27, and 31 were easier in 2000-01 than in 2005-06. Items 3, 4, 7, 8, 11, 13, 15 - 18, 20, 25, and 30 had almost identical parameter estimates.

Figure d2-7 DIF Analyses for 2000-01 and 2005-06 – Form 17



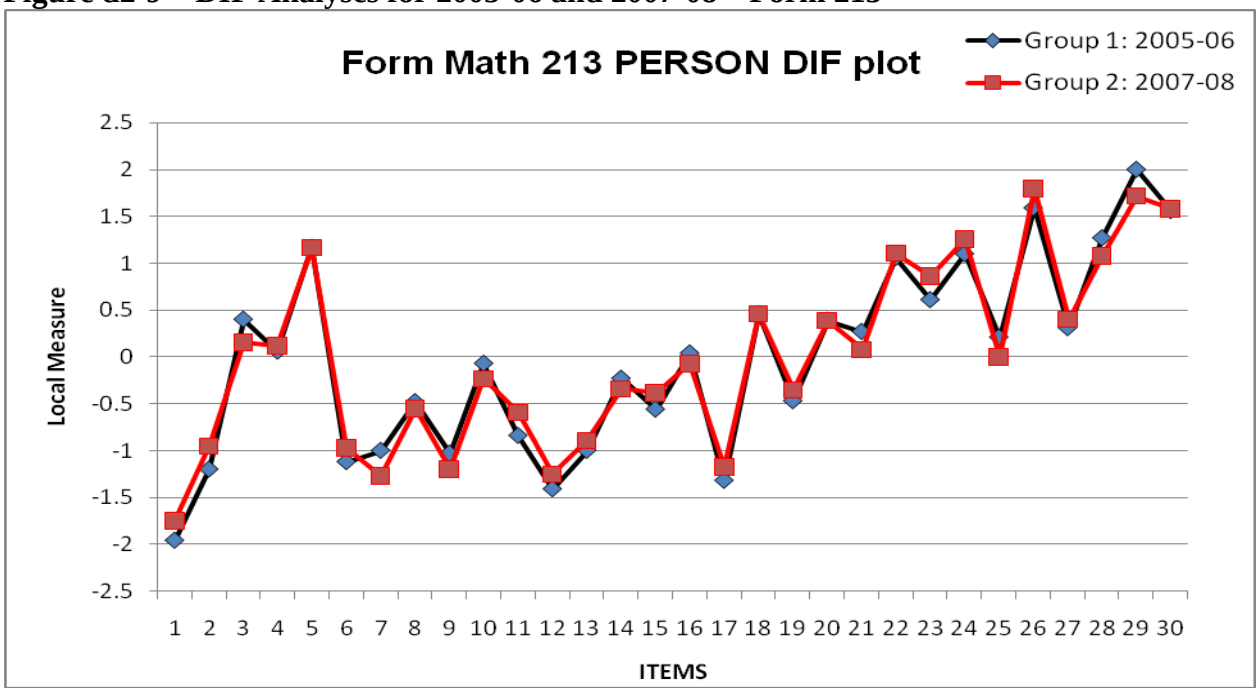
On Form 18 (Figure d2-8), items 9, 10, 13, 14, and 15 scaled to be slightly easier in 2005-06 than 2000-01. Items 3, 30, 31, and 32 were easier in 2000-01 than in 2005-06. Items 2, 4, 5, 6, 11, 18 – 22, 26, 27, and 29 had almost identical parameter estimates.

Figure d2-8 DIF Analyses for 2000-01 and 2005-06 – Form 18



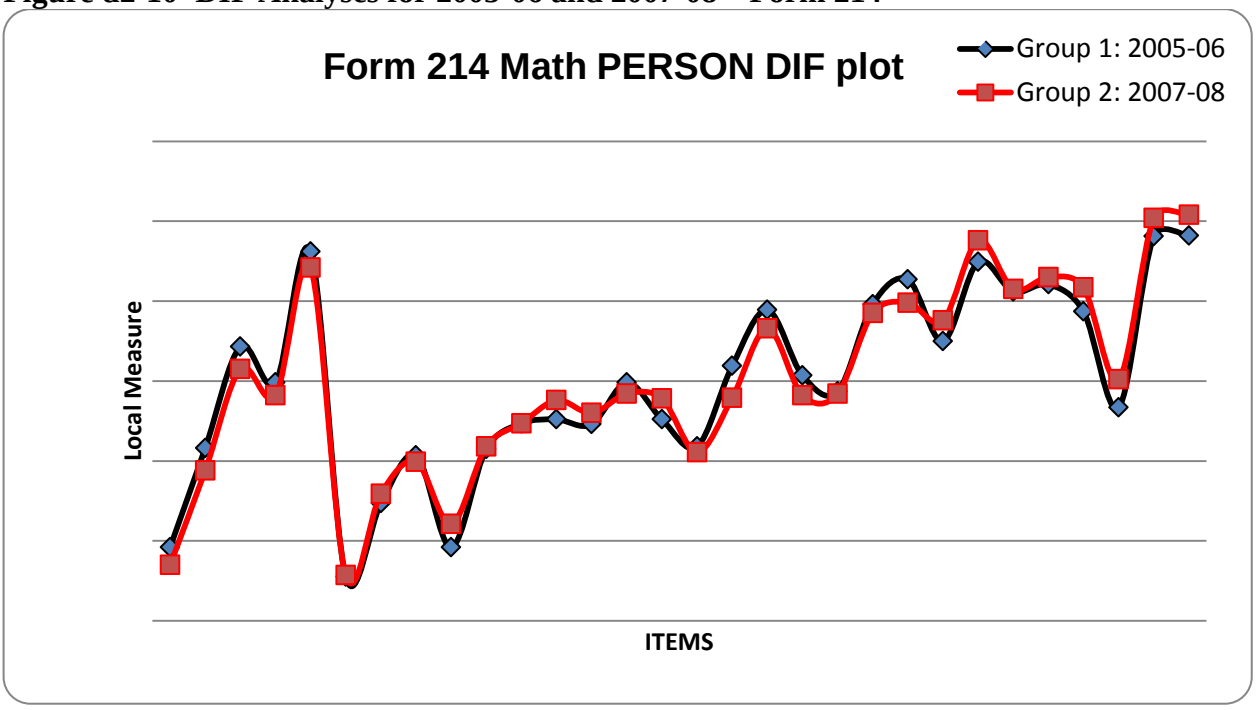
On Form 213 (Figure d2-9), Items 4, 5, 8, 13, 14, 16, 18, 19, 20, 22, 27, and 30 had almost identical parameter estimates. Items 3, 7, 9, 10, 21, 25, and 28 scaled to be slightly easier in 2005-06 than 2000-01

Figure d2-9 DIF Analyses for 2005-06 and 2007-08 – Form 213



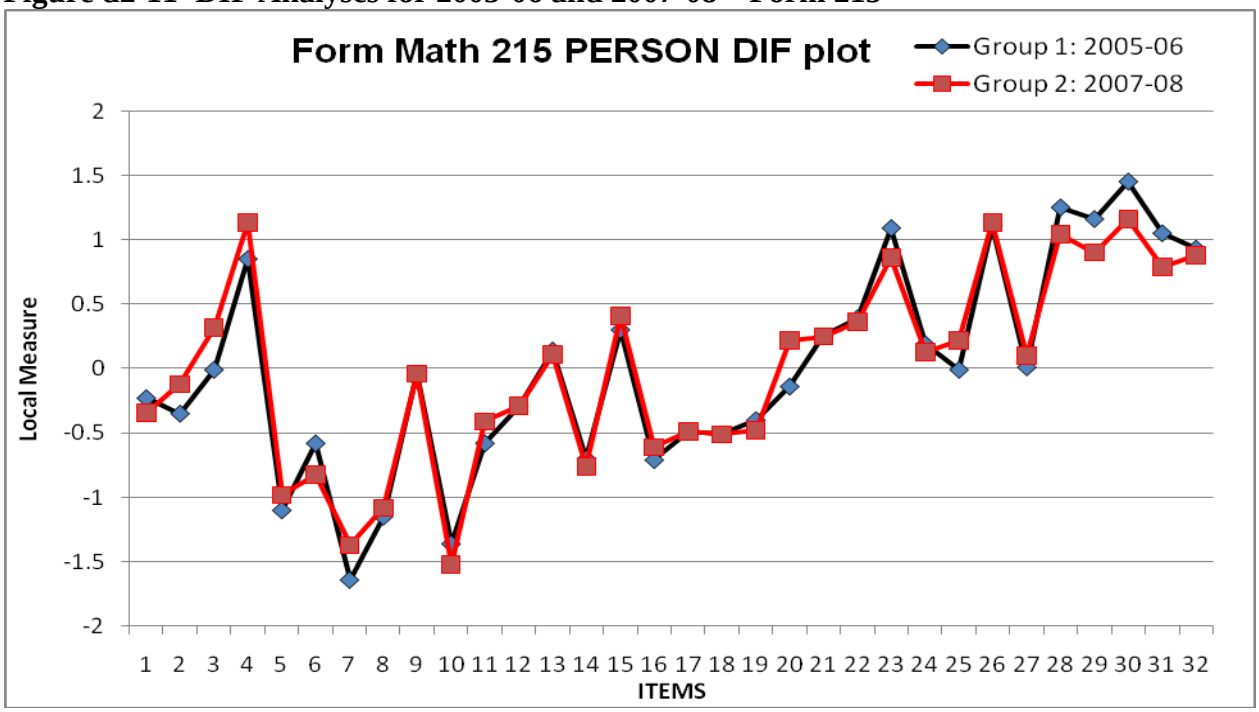
On Form 214 (Figure d2-10), Items 6, 7, 8, 10, 11, 16, 20, 21, 25, and 26 had almost identical parameter estimates.

Figure d2-10 DIF Analyses for 2005-06 and 2007-08 – Form 214



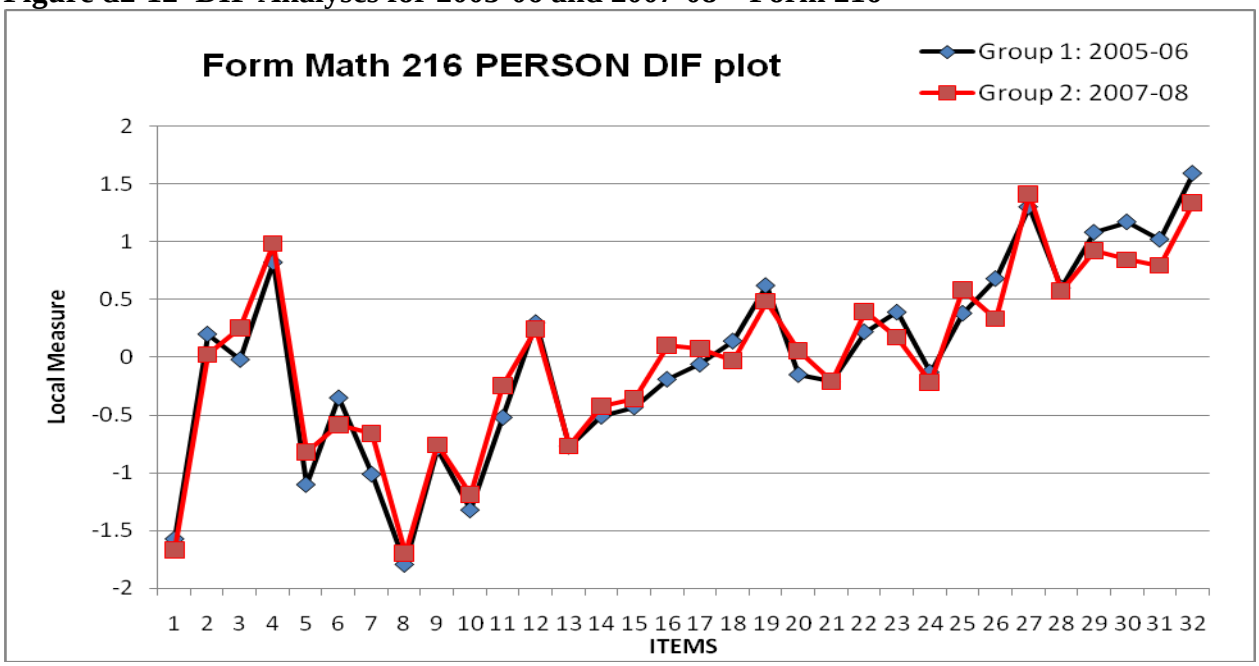
On Form 215 (Figure d2-11), Items 5, 8, 9, 12, 13, 14, 16 – 19, 21, 22, 24, 26, 27, and 32 had almost identical parameter estimates. Some items became eaiser in 2005-06 compared to 2000-01 and vice versa.

Figure d2-11 DIF Analyses for 2005-06 and 2007-08 – Form 215



On Form 216 (Figure d2-12), Items 8, 9, 12 – 13, 21, 24, 27, and 28 had almost identical parameter estimates.

Figure d2-12 DIF Analyses for 2005-06 and 2007-08 – Form 216



Stability of Item Parameter Estimates – Mode of Delivery

The ECS and WLS series of tests were transferred from paper and pencil (PPT) to computer to offer a more convenient and efficient option for test administration and delivery. Among the advantages of a computer-based test (CBT) over PPT are the following:

- score results are available immediately
- errors associated with bubbling are eliminated
- effort to administer tests is greatly reduced
- scoring errors are practically eliminated
- test security is improved

Since the CBT version of the ECS and WLS tests were designed to be no more than a different mode of delivery, every effort was made to ensure comparability. The initial concern of comparability is that of a potential mode effect (APA 1986). Numerous studies have compared the test scores of PPT versus CBT to determine their effect. Reviews of many of these studies were conducted by Mazzeo and Harvey (1988) and by Mead and Drasgow (1993). The overall results of these reviews of comparability show that the test administration mode did not result in significant differences in test score for most tests. However, some items and item types did produce mode differences.

Item displays were produced with near perfect fidelity by making screenshots from the source file Microsoft Word™ documents. In the vast majority of cases the display fit in the available screen space and thus no changes were made. Three items were slightly reduced in size in order to fit the available screen size. These items are indicated in Table d2-7. At Level C a total of 6 out of 114 items required vertical scrolling in order to present displays at the same scale as in P&P. At Level D a total of 9 items out 60 required vertical scrolling.

Scrolling was generally avoided at the A and B levels where students were judged by the development team to likely have less facility with scrolling. Stems and item responses the PPT tests used Times New Roman 12 for the font. However, in the transition to CBT, this font was deemed less legible on computer screen so all stems and item responses were uniformly changed to Arial 14.

Table d2-7 Changes to Display within the ECS Series

Level	Form	# of items	Scroll bar	Other changes to display
Appraisal	130M	25	no	none
Appraisal	230M	25	no	none
A	11M	24	no	none
A	12M	31	no	none
B	13M	31	no	none
B	14M	31	no	none
C	15M	31	no	none
C	16M	31	no	none
D	17M	32	no	none
D	18M	32	no	none

Table d2-8 Changes to Display within the WLS Series

Level	Form	# of items	Scroll bar	Other changes to display
B	213M	30	no	10,15,17,19,20 - colored
B	214M	30	no	10,14,19,20 - colored
C	215M	32	no	14 - colored
C	216M	32	no	13 - colored

Another concern of comparability of delivery modes is that of students' familiarity with computers. In response to these potential concerns, the CBT software includes a tutorial about how to use the computer for the test and also administers a practice test of 6 items. This allows students with little to no computer experience to practice using the mouse and navigating through the test prior to live administration. The test is also designed so that it can be operated exclusively from the keyboard as an alternative to using the mouse.

Comparability Analysis – CBT and Paper and Pencil Test Administrations

Methodology

Beyond the design features described above, CASAS also conducted comparability analyses between tests administered via computer (CBT) and the more traditional paper and pencil test booklets (PPT). The logistics of many adult education programs that use CASAS tests requires assessments to be delivered both via computer and paper and pencil. To analyze the comparability of the two delivery modes, samples of students across all CASAS assessment series and spanning all NRS Educational Functioning Levels were administered two tests – one via computer and another via paper and pencil – on back-to-back days. The order of administration was alternated among testing groups to counterbalance the potential practice effect of taking the same tests over a short interval. The students were convened to take an appropriate CASAS test based on their NRS Educational Functioning Level.

On day one, half of the group took the PPT version of the test and the other half took the CBT version of the test. The following day the examinees were reconvened and were administered the tests again using the alternate delivery mode – those who were tested with the PPT on day one received the CBT version on day two and vice versa. Adult schools from California, Connecticut and Florida participated in the study. See Table d2.9.

Table d2-9 Agency Participants

CBT and PPT Study Participants	State	Number of Students
Agency #1	CA	202
Agency #2	CA	257
Agency #3	CA	49
Agency #4	CA	22
Agency #5	CA	33
Agency #6	CT	45
Agency #7	FL	20
Agency #8	FL	24
Agency #9	FL	29

Students functioning at different NRS Levels took part in the study. Students included in this study collectively form a representative sample of the intended population such that the results can be generalized to that larger population. See Table d2.10.

Table d2-10 Student Participants

CASAS Scale Score Range	NRS Functional Level	Number of Students
Less than 200	ABE Beg Lit, ESL Beg Lit, ESL Low Beg, ESL High Beg	78
201-210	ABE Beg Basic, ESL Intermediate Low	113
211-220	ABE Intermediate Low, ESL Intermediate High	129
221-235	ABE Intermediate High, ESL Advanced	249
236-245	ASE Low	83
246 and above	ASE High	29

Results show that both delivery modes produced similar mean scale scores, standard deviations, and rank ordering of scores for select forms of the tests that were included in these studies. The data, including correlations shown in Table d2-11 provides an estimate of the reliability of scores from the same forms administered to the same student via computer and paper and pencil. The correlations are statistically significant for all the forms in the table at the 0.01 level (2-tailed). The average scores for both CBT and PPT were also very similar with further analysis of these data described below in Table d2-11.

Table d2-11 Correlation between CBT and PPT

Math Form	No. of Items	N	Mean Scale Score		Standard Deviation		Correlation	Correlation Significant
			CBT	PPT	CBT	PPT		
13M	34	53	210.65	211.71	8.565	7.924	0.86	0.00
15M	36	53	224.92	226.02	9.181	9.295	0.84	0.00
17M	32	39	228.53	228.84	7.388	7.302	0.83	0.00

Note: Forms with less than 25 students who took the test twice in CBT and PPT are not reported in this study

Table d2-12 shows results from paired samples t-test calculations that compare the mean scale score obtained from the CBT and PPT tests both administered to a single group of students at different times. The paired samples t-test can be used to evaluate whether two means are different from each other when the two samples that the means are based on were taken from the matched individuals or the same individuals. According to the result of these t-tests the mean scaled score between the two modes of administrations were not statistically significant ($p >= 0.05$) suggesting that scores observed on PPT and CBT were not different. These results provide evidence of the comparability of interpreting scores on both modes.

Table d2-12 Paired-Samples T Test on CBT and PPT

Math Form	95% Confidence Interval		t	df	Sig. (2-tailed)
	Lower	Upper			
13M	-2.321	0.198	-1.694	48	0.097
15M	-2.621	0.413	-1.464	47	0.150
17M	-1.723	1.091	-0.455	37	0.652

Figures d2-13 through d2-15 shows the score distribution between the CBT and PPT administration of the same forms.

Figure d2-13 Score Distribution CBT to PPT –Form 13

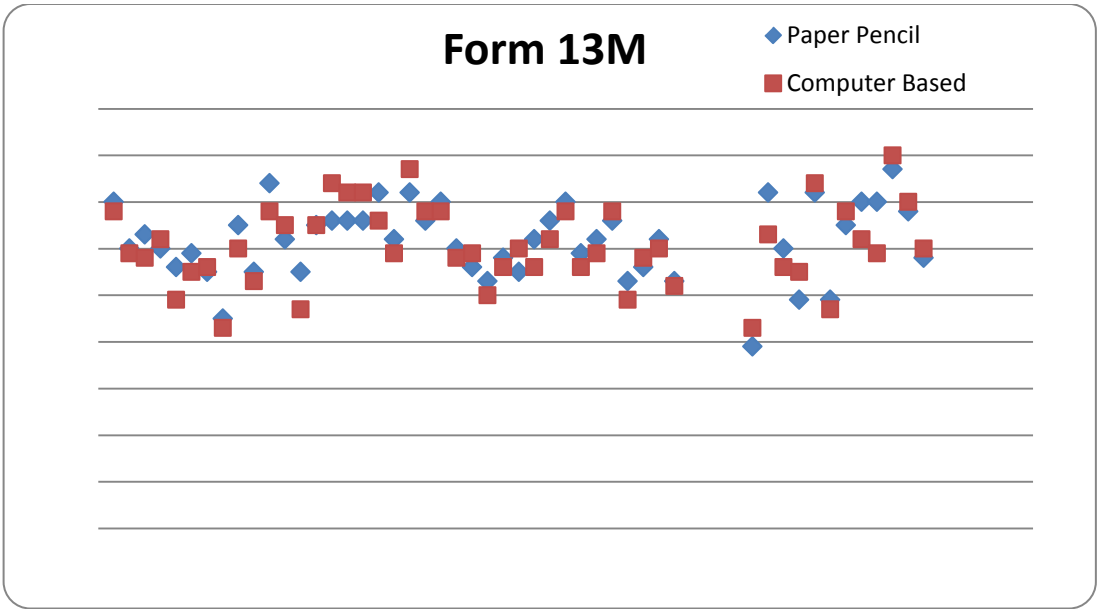


Figure d2-14 Score Distribution CBT to PPT –Form 15

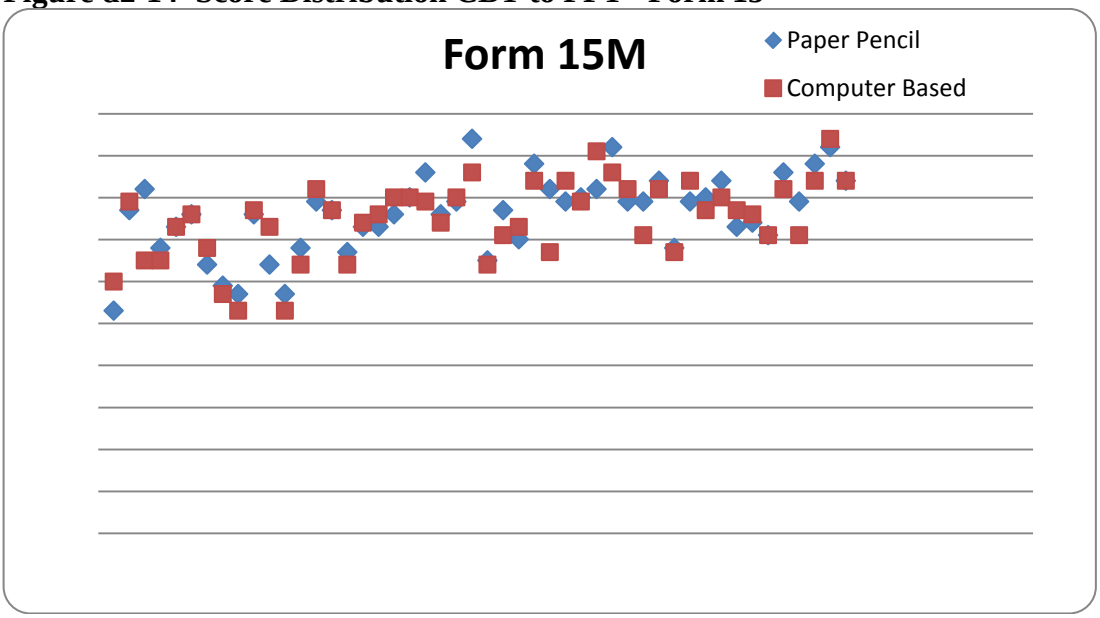
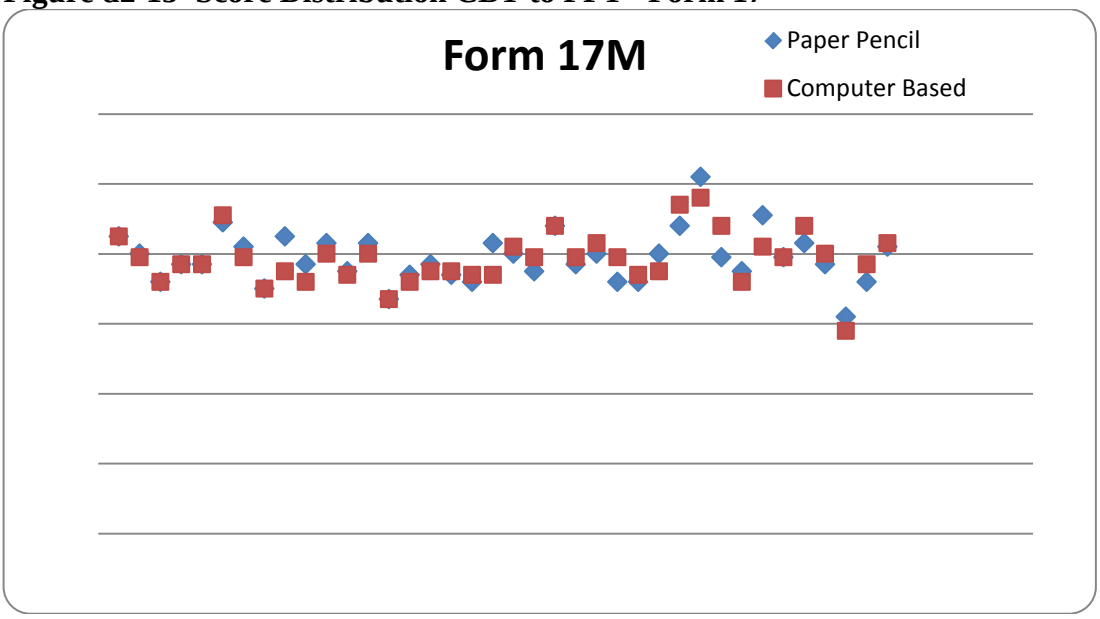


Figure d2-15 Score Distribution CBT to PPT –Form 17



In addition to evaluating the difference of the means, score distributions CASAS also analyzed the descriptive information that is available through classical test theory. Table d2-13 shows the results of these analyses. It is important to note that the standard errors of measurement (SEM) between modes of administration were very similar. Other diagnostic measures of item quality (e.g., item difficulty, item discrimination) were also similar for both CBT and PPT modes.

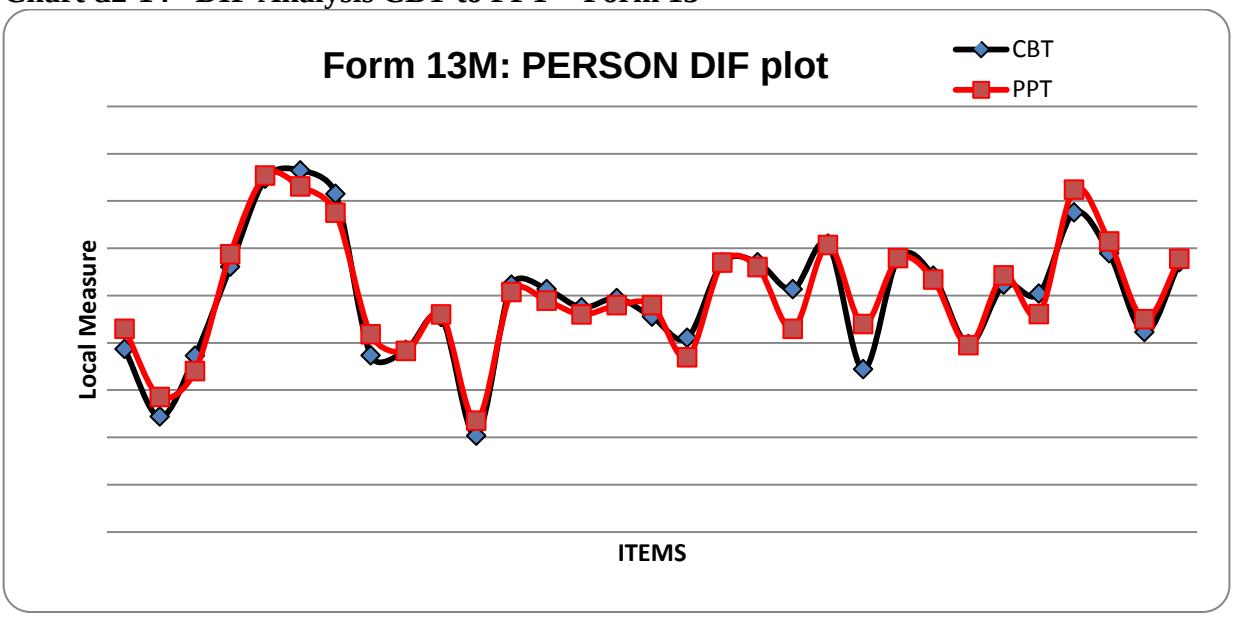
Table d2-13 Comparability of Descriptive Statistics – CBT and PPT

Math Forms	Math 13M		Math 15M		Math 17M	
Descriptive Statistics	CBT	PPT	CBT	PPT	CBT	PPT
Alpha	0.835	0.828	0.827	0.819	0.765	0.784
SEM	2.309	2.328	2.346	2.322	2.319	2.362
Mean P	0.562	0.57	0.596	0.617	0.371	0.382
Mean Item-Tot.	0.407	0.4	0.398	0.393	0.33	0.359
Mean Biserial	0.549	0.538	0.527	0.533	0.454	0.492
Max Score (Low)	14	14	16	16	9	9
N (Low Group)	14	17	15	14	13	14
Min Score (High)	22	22	23	22	14	14
N (High Group)	15	18	13	17	13	15

To further evaluate the comparability between administration modes across these selected test forms, we conducted one additional series of analyses. Because classical test theory statistics are sample dependent, this second level of analyses occurs at the item level and relies on item response theory (IRT) principles to control for different abilities. Using IRT, specifically the Rasch model, differential item functioning (DIF) analyses were conducted between the CBT and PPT as the reference and focal groups respectively. Data for DIF analysis is run in the Winsteps software. Figures d2-14 through d2-16 show the results of the DIF analysis. Item parameters for the forms are compared on the logit scale based on 10 and a mean of 200. For all forms there were some items that scaled to be slightly easier for CBT and some that scaled to be slightly easier for PPT. Many of the items had almost identical

parameter estimates. From these graphs it appears that there are no systematic shifts in item difficulty from CBT and PPT. A brief description of the findings from each analysis is included after each graph.

Chart d2-14 DIF Analysis CBT to PPT – Form 13



On the math form 13M (Figure d2-14), items 4, 5, 9, 10, 12-16, 18, 19, 21, 23-26, and 29-31 had almost identical parameter estimates. Items 1,2, 8, 11 and 28 scaled to be slightly easier in CBT than in PPT. Items 3, 6, 7, 17 and 27 were easier in PPT than in CBT. Item 20 shifted over half a logit easier in CBT than PPT. Item 22 shifted over half a logit easier in PPT than CBT.

In form 15M (Figure d2-15) items 1-4, 7-9, 12, 13, 16, 17, 19, 21, 22, 24, 26, 27, 30 and 31 had almost identical parameter estimates. Items 5, 10, 14, 18, 23 and 28 were easier in CBT than in PPT. Items 6, 20, and 29 were easier in PPT than in CBT. From these data, only item 11 was identified for review for showing significant variation.

Figure d2-15 DIF Analysis CBT to PPT – Form 15

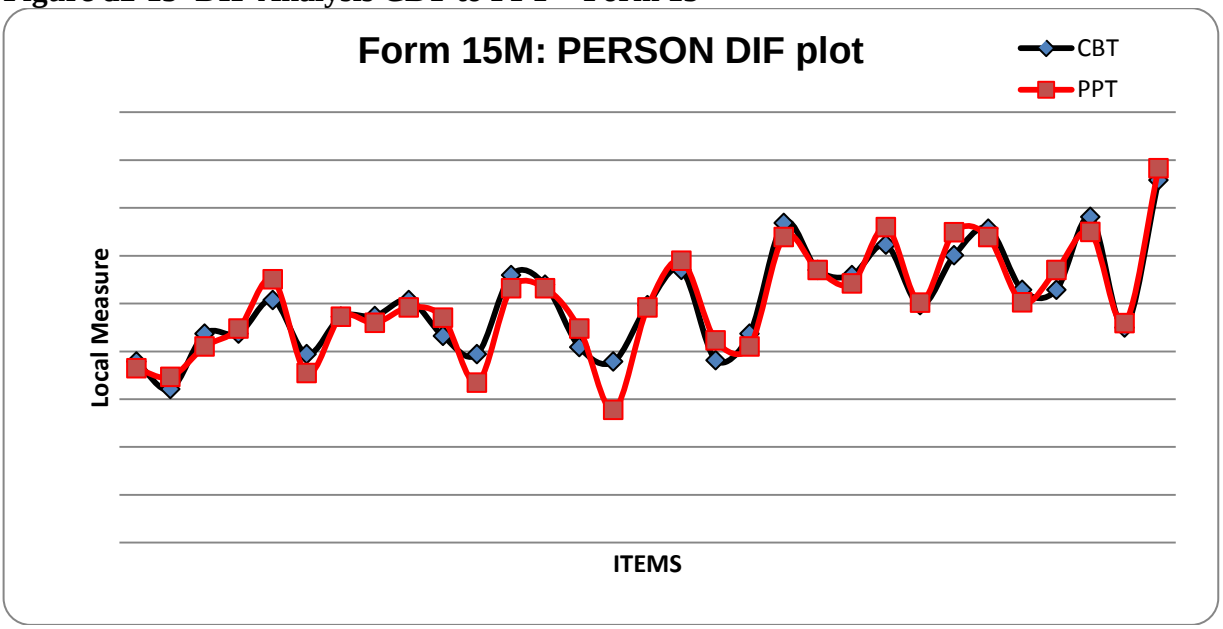
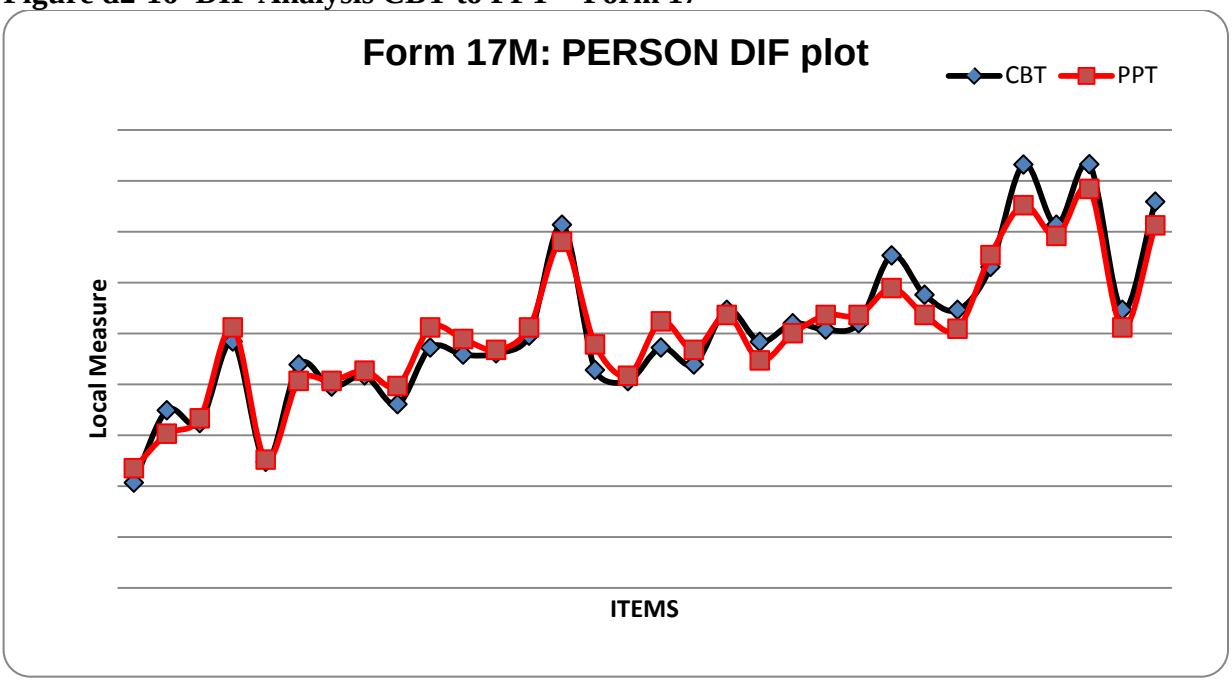


Figure d2-16 DIF Analysis CBT to PPT – Form 17



On form 17M (Figure d2-16) items 1, 3-5, 7, 8, 12, 13, 16, 19, 21-23, 27 and 29 had almost identical parameter estimates. From these data, only items 24 and 28 were identified for review for showing significant variation.

Item d3 – The steps taken to maintain the security of the test

CASAS ascribes to all the rights and responsibilities of test administrators, proctors, and test takers as spelled out in the *Standards for Educational and Psychological Testing* (AERA, APA, & NCME, 1999). Test security policy issues are discussed on an ongoing basis with the CASAS National Policy Council and National Consortium member state representatives at biannual meetings and special conference calls. CASAS, together with the National Consortium members, has developed, and updates as necessary, state and local assessment policy guidelines regarding how security concerns should be reported, the score appeal processes, and the rights and responsibilities of test administrators, proctors, and test takers. CASAS recommends that states incorporate these policy guidelines into their state and local-level assessment policies. Overall responsibility for test security policy rests with both the director of assessment development and the director of program development.

Test security is maintained throughout the life cycle of all CASAS testing, from development to administration and the scoring and reporting stages.

Item and Test Security during Development and Field Testing Process

The item and test development department is responsible for all aspects of the development and field-testing process. The item materials are kept secure at the CASAS offices and access is limited to authorized members of the item and test development department. During the field-test process, materials are sent to the test administrator who is instructed on procedures and policies to keep field-test materials secure. More information on test administration policies is provided below.

Upon completion of the field-testing, all test materials are returned to CASAS, and each test booklet is logged in and checked off to ensure that all booklets are accounted for. At CASAS offices all forms are kept in a secure location and access to items and test forms is strictly controlled and limited to members of the item and test development department, the research and development department, and in the case of items to be sent or received by CASAS, the shipping and receiving department.

CASAS Item Bank

The item bank for the ECS Math series is organized to be a comprehensive source of information for the item and test developers. The database consists of easy-to-reference and up-to-date information on each item. Item C in this document describes the information contained in the CASAS item bank for the ECS Math series.

CASAS policy is to have a selection of reserve items in the CASAS Math Item Bank. These reserve items span the difficulty levels and content areas for each math test series and provide a pipeline of available items.

These reserve items are available should specific items become compromised and it is determined that these items must be replaced. These items are also available if CASAS determines, through the continuous analysis of psychometric properties, that an item or item set does not remain reliable, valid, fair, or sensitive to demographic groups.

Access to the CASAS item bank is strictly controlled and the bank is stored on a secure file server location and access is limited to members of the item and test development department and the research and development department. These security controls eliminate unauthorized access.

Test Publication and Distribution

Detailed records are maintained by CASAS regarding the distribution of all exam materials. The responsibilities of test administrators are detailed below. During and after the publication process all electronic materials are stored on a secure file server. Access is limited to members of the item and test development department, research and development department, and in the case of items to be delivered or received by CASAS, the shipping and receiving department. As with the distribution of field-testing materials, the distribution of all test materials is strictly controlled and all testing material inventory must be reconciled and accounted for.
This chain-of-custody process in place specifies the responsible CASAS staff at each step of the development, publication, and distribution process.

Security and Confidentiality of Examinee Data

All examinee field-test answer sheets are returned to CASAS where they are scored on site. All answer sheets and subsequent databases containing test information and results are stored in secure files.

Access to examinee data is strictly controlled and limited to the item and test development department and the research and development department. Before items are analyzed by members of the Research and Development Department, student-level identifying information is removed from the data files. When examinee data is analyzed as part of the process to determine the continued validity and reliability of test scores, all identifying variables are removed from the datasets and any summary reports. Test professionals who have access to examinee data and results must sign confidentiality agreements. When aggregate examinee results are supplied to outside parties, the permissible use of these results is communicated to these parties. Outside parties are educated on the proper interpretation of scores. In addition, possible incorrect uses of examinee information and scores are identified and communicated to outside parties using the scores or test results.

As described above, for ongoing test security of existing test forms, local agencies are instructed during required training on the procedures and processes they are mandated to follow. In addition to test security information covered during training, all agencies automatically receive test administration manuals that include required test security measures. The test administration manuals (TAMs) for all CASAS assessments contain information on test security as presented in Tables d3-1 and d3-2.

All CASAS software applications are encrypted including databases and program files. The software applications are password protected with the ability to set different permissions and access levels for individual users. All online data transfer and updates use HHTPS, a secure file transfer protocol that provides encryption and a secure channel over an insecure local network system.

Test Administrators Responsibilities

In accordance with Standard 13.10 of *The Standards of Educational and Psychological Testing* (AERA, APA, & NCME, 1999), the CASAS professional development department provides training and training materials to test administrators. When an agency places an order for CASAS assessments, the test coordinator must sign a Training and Test Use Agreement as presented in Table d3-2. The test coordinator must indicate who has been trained, date and location of training, and name of the CASAS certified trainer. This information is verified at the CASAS office by the customer service department before an order can be processed and shipped. If an agency has not completed training, that agency is provided with training options, and CASAS test materials are not shipped until the agency has satisfactorily met the training requirement. Table d3-1 below includes the information provided in the CASAS test administration manual.

A test administrator or proctor must be present at all times during any testing session. If there are more than 25 examinees, CASAS requires that a second additional proctor be present.

During administration of the CASAS exams, the responsibility for maintaining test security is the responsibility of the test administrator or proctor. Proctors are trained to observe examinees to ensure that they are not using prohibited materials or devices. For example, proctors must be aware that small electronic devices such as cell phones, voice recorders, and personal digital assistants are not used to capture the items to which examinees are exposed. Proctors are instructed to verify examinee identity and communicate to examinees the importance of not sharing information regarding specific items with others.

Table d3-1 CASAS Test Security Policy from Test Administration Manual

CASAS publishes this test security policy to maintain the integrity of each of its assessments and to assist with the implementation of and adherence to the test security practices contained in this document. Administrators and testing personnel are responsible for following these practices and ensuring that agency staff are aware of and follow said practices.

It is the immediate legal responsibility of the agency director, principal, or other primary administrator to enforce securing testing materials *upon taking delivery of materials and at all times afterward.* Only testing personnel and others qualified as part of the testing process may have access to any testing materials.

Security of Testing Materials

All testing materials, including but not limited to computerized-testing versions of CASAS eTests, whether online or desktop, test booklets, CDs, answer sheets, and answer keys, must be kept *secure.*

No unauthorized personnel should be allowed access to CASAS eTests or to paper test booklets. Security procedures for computerized-testing and paper test booklets must be held to the same standard.

Test Administration

Testing personnel must remain in the testing room throughout an entire test session to ensure that students follow all testing rules. Examinees must sit three to five feet apart and refrain from talking during the testing session or seeking help from others in any way, including use of electronic devices.

Testing personnel must ensure that they follow all test administration directions and language as dictated in the appropriate CASAS Test Administration Manual.

> ***CASAS eTests*:** CASAS will occasionally embed unpublished test items into operational CASAS eTests in order to maintain and build its item bank. These items are not scored. The security of these items cannot be compromised and must be maintained in the same manner as all testing materials.
>
> ***Paper test booklets**:* Paper test booklets and related test support materials should be kept in locked storage at all times when not in use. Prior to distribution of test booklets, the test administrator must number each test booklet for tracking purposes. As examinees finish the test, they must put their answer sheet inside their test booklet and wait until the conclusion of the testing session. The administrator must ensure that each test booklet is returned before anyone leaves the testing facility.

Confidentiality of Tests and Test Items

No agency, school, or other entity may use any CASAS test or test item – published or unpublished – as a tool to prepare examinees for the testing process. CASAS tests may never serve as practice tests in any capacity or for any purpose. Test items may not be reviewed, discussed, or explained to anyone at any time.

Table d3-1 CASAS Test Security Policy from Test Administration Manual (cont.)

> ***Paper test booklets:*** If test booklets have been marked in or torn, agencies should shred these test booklets. If an agency is transitioning to a new test series, CASAS requests that agencies shred old test booklets and destroy related testing materials including CDs. It is never appropriate to retain test materials for use as a practice test or for instructional purposes.

No agency, school, or other testing entity may share or provide any testing materials to another agency or school. Agencies that make such requests should be advised to contact CASAS directly. Testing materials must remain at the testing site at all times.

Copyright Infringement

No test materials may be duplicated, photocopied, or reproduced in any manner. Federal copyright law prohibits unauthorized reproduction and use of copyrighted test materials. Reproducing test materials is a violation of federal copyright law.

Test Security Policy

Agency directors, principals, and other primary administrators need to maintain a specific test security policy that discusses the proper handling and use of test materials.

All testing personnel must sign the **Test Security Policy** statement below agreeing to uphold the security policies of the agency, school, or testing entity.

Should CASAS determine that any agency, school, or other testing entity has violated any provision of this test security policy or that testing materials have been compromised in any manner, purposely or otherwise, CASAS reserves the right to take appropriate action to rectify the violation of its test security policy.

Table d3-2 Agency Test Security Policy from Test Administration Manual

To protect the quality and standardization of CASAS assessments, I agree to:

1. Follow all test procedures as required in this Test Security Policy document.
2. Secure all CASAS test materials, whether paper-based or computer delivered, under lock and key except during testing sessions.
3. Ensure that before or after any test administration all test materials are secure and inaccessible to any non-testing personnel, examinees, or others not responsible for test administration.
4. Remain in the testing room at all times during the testing event and monitor all examinee activity as appropriate and in compliance with test security procedures.
5. Ensure that examinees sit at least three to five feet apart and do not talk or seek help from others during the testing event in any way, including use of electronic devices.
6. Refrain from assisting examinees with test answers on any test before or during the testing event.
7. Refrain from reviewing test questions with examinees after the testing event.
8. Ensure that agency staff members follow all specific testing procedures as stated in CASAS Test Administration Manuals.
9. Disallow use of any CASAS assessments as practice tests or as instructional tools.
10. Advise any agency, school, or testing entity to contact CASAS, and not my agency, with any inquiry about sharing or duplicating CASAS testing materials.
11. Refrain from duplicating or in any way reproducing any CASAS testing materials, including but not limited to test booklets, answer keys, answer sheets, CDs, and CASAS eTests.
12. Report any violation of this test security policy.

My signature on this document certifies that I have read the above policy, will follow all test administration directions as stated in my CASAS Test Administration Manual, and agree to abide by all test security procedures.

Signature	Position/Title	Date

Print name

Detecting and Reporting Security Concerns

All users of CASAS tests are to have procedures in place for any instance where the security of an examination has, or is suspected of having been breached. As agreed to by CASAS and National Consortium members, all security concerns are to be reported to the local assessment coordinator. If a matter is not resolved, the concern is to be referred to the state assessment coordinator. State staff members are required to monitor WIA II funded programs on an annual basis to make sure test security procedures are being followed. All users of CASAS tests are provided contact information to report directly to CASAS any information related to the security of CASAS items and test forms, including the potential compromise of test items.

In addition, CASAS reviews aggregate test data on a yearly basis to examine potential security concerns including improper or fraudulent test usage. This includes improper use by test administrators and teachers. CASAS conducts a series of data integrity checks by which CASAS is able to help identify potential misuse. Training sessions and the ECS Math Test Administration Manual (TAM) strongly emphasize the inappropriateness of improper test preparation including teaching to specific items. The manual states:

It is prohibited for any individual, school, program, or business enterprise to develop any workshop, training or instructional session or create any materials designed to teach or prepare students to answer specific questions that appear on any CASAS test.

CASAS has an item and test security monitoring group to monitor the potential for illegal sharing of CASAS test items or improper test preparation. This monitoring is done via internet searches, regular meetings with trainers and program specialists, meetings with the research and development department, and review of data integrity reports. Any suspicion of improper usage is addressed immediately through a meeting with CASAS executive management. The item and test security monitoring group and CASAS executive management team decide on the proper course of action. This may involve requesting the development of additional items and scheduling pilot studies and field-test studies, replacing or retiring compromised items or forms, requesting the analysis of data or other studies to determine the scope of the issue, and initiating appropriate action against parties using CASAS items or tests in an inappropriate manner.

CASAS Response to Security Concerns

As mentioned above, if a potential security concern is detected, the CASAS item and test security monitoring group meets with CASAS management. Based on the issue, the item and test development department and the research and development department will also be included in discussions to address the appropriate next steps in each of the following areas:

- What evidence has been obtained regarding the security concern?
- What is the extent/potential impact of the security concern?
- Potentially what communication is required to CASAS test users?
- Potentially what other communication is needed (media release, etc.?)
- What additional analyses need to be conducted regarding this concern?

- Based on the decisions made, what replenishing of the CASAS item bank may be necessary?

All communication from CASAS to CASAS test users is through the director of assessment development and the director of program development.

Test Taker Rights

All users of CASAS tests are to have the right to appeal a test score as described in Standard 8.13 in the *Standards for Educational and Psychological Testing* (AERA, APA, & NCME, 1999). As agreed to by CASAS and National Consortium members, test score appeals are to be reported to the local assessment coordinator. If a matter is not resolved, the concern is to be referred to the state assessment coordinator. If a local agency contacts CASAS directly, the person is referred to their state assessment coordinator.

Other test taker rights also follow the guidelines outlined by the *Standards for Educational and Psychological Testing*:

- Examinees whose results are invalidated are informed of available means of appeal or recourse (Standard 8.13).
- CASAS arranges for rescoring of examinee scores upon request (Standard 11.10).
- Examinees are informed of CASAS retake and reporting policies (Standard 11.12).
- The purpose of the testing is explained to students – that there are no pass or fail scores, that pretests are to inform instruction, and that post-tests are to measure progress (Standard 8.2).
- Test results and score interpretations are shared with examinees in language that the examinee should reasonably be expected to understand (Standard 12.20).
- Examinees are offered up to three retest opportunities to succeed on equivalent forms of the ECS Math assessments. CASAS guidelines state that the recommended interval between consecutive pre- and post-test administrations is between 70-100 hours (Standard 13.6)

Item Exposure Analysis

As part of periodic psychometric maintenance for assessment programs, CASAS evaluates the stability of item parameter estimates over time (Wendler & Walker, 2006). If item characteristics substantively change over time, it raises a potential threat to the validity of intended score use and interpretations. When these item parameter changes influence decisions about items or the scale, it is often called item parameter drift or scale drift (Yen & Fitzpatrick, 2006). As outlined in Standard 4.17 of *The Standards of Educational and Psychological Testing*, CASAS periodically checks the stability of the measurement scale and the respective scores on the scale. To evaluate item parameter drift, CASAS conducts two types of analyses. First, CASAS analyzes classical item statistics across all items contained in the item bank. Because classical test theory statistics are sample dependent, a second level of analyses occurs at the item level and relies on IRT principles to control for different abilities. Using IRT, specifically the Rasch model, differential item functioning (DIF) analyses are

conducted using item performance from different testing periods as the reference and focal groups to examine if there are any statistically significant changes in item functioning over different testing periods.

Test security is maintained throughout the life cycle of the ECS Math Assessments, from development to administration and the scoring and reporting stages. During the field-test process, materials are sent to the administrator who is instructed to keep them in a secure area. Upon completion of the field testing, all test materials are returned to CASAS and each test booklet is logged in and checked off to ensure that all booklets are accounted for. All answer sheets are returned to CASAS where they are scored on site. All answer sheets and subsequent databases are stored in secure files. Before items are analyzed by experts as part of item calibration studies, any student-level identifying information is removed from the data files.

For ongoing test security of existing test forms, local agencies are instructed during required training on the procedures and processed they are to follow. In addition to test security information covered during training, all programs automatically receive test administration manuals that include test security measures. The Test Administration Manual (TAM) for the ECS Math Assessments contains the following excerpts related to test security:

> ***Confidentiality of Test Questions***
>
> *It is prohibited for any individual, school, program, or business enterprise to develop any workshop, training or instructional session or create any materials designed to teach or prepare examinees to answer specific questions that appear on any CASAS test. It is also not permissible for teachers to go over test items with examinees in discussing test results, as this may affect performance on future tests.*
>
> *CASAS encourages the use of the Student Performance by Competency and the Class Profile by Competency reports to inform instruction. In addition, CASAS provides a complete set of competencies and content standards, the Instructional Materials QuickSearch, and other CASAS support materials that relate curriculum to assessment.*
>
> ***Test Security***
>
> *Agencies must keep all testing materials, including test booklets, answer sheets, test manuals and related materials in secure storage, available only to those involved in test administration. CASAS strongly encourages agencies to develop a system to distribute and collect testing materials, including numbering the test booklets. Test administrators are responsible for the security of all test materials in their possession.*

Test Security Agreement

The following are guidelines suggested for inclusion in a local assessment policy. Agencies use these guidelines and others to customize their assessment policy depending on the

requirements, such as the requirement of signing an annual test security agreement, set forth by their department of education.

A. The local adult education program director or administrator assumes responsibility for safeguarding all CASAS-developed assessment materials, including test administration manuals and answer sheets (which contain marks or responses).

B. All CASAS materials are stored in a locked, preferably fireproof, file cabinet accessible to the program director or administrator, or their designee(s).

C. Staff members who administer assessments return all materials immediately after their use to the program director or administrator, or their designee(s).

D. All answer sheets and writing samples are treated as confidential until destroyed.

E. Duplication of any test form or any portion of any test form for any reason is prohibited.

F. The adult literacy provider maintains inventory information of CASAS materials and will supply this information to their Department of Education upon request.

G. Defaced materials are not destroyed, unless authorized by the Department of Education.

H. Adult literacy providers may not use displays, questions, or answers that appear on any CASAS test to create materials designed to teach or prepare examinees to answer CASAS test items. Instead, programs are to use instructional resources provided by CASAS QuickSearch and other support materials to link curriculum, assessment, and instruction.

(e) Match of the content to the NRS educational functioning levels (content validity). Documentation of the extent to which the items or tasks on the test cover the skills in the NRS educational functioning levels

Item e1 – Whether the items or tasks on the test require the types and levels of skills used to describe the NRS educational functioning levels

CASAS has developed a variety of documentation to provide evidence as to the comparability of test content to the types and levels of skills used to describe the NRS educational functioning levels.

Figure e1-1 presents the relationship between content standards and competencies. The CASAS assessment system links and aligns the following key elements: curriculum (including specified underlying basic skills content standards as well as competencies negotiated and agreed upon by at least an 80 percent consensus of a national consortium of states using CASAS), suggested instructional materials and guides aligned to assessments and indexed to competencies and task areas, and assessments aligned with the competencies and content standards, as well as instructional materials. This provides the base of information needed to support and reinforce the learning process. Assessment becomes an integral part of instruction and instruction becomes targeted to the identified needs of learners. Through this system, the progress of each student can be monitored so that the agency and the learner are aware of specific outcomes or goals attained.

Tables e1-1 through e1-3 directly compare the NRS Numeracy and Functional and Workplace Skills Level Descriptors to the corresponding CASAS Math and Employability Skill Level Descriptors.

Table e1-3 provides information on the content standards measured by the *ECS Math Assessments*. Content standards for ABE, ASE are defined as clear statements about what learners should know and be able to do at specific points along an educational pathway. They are used together with CASAS Competencies to guide and focus instruction. Table e1-3 lists all the content standards addressed by the forms in the *ECS Math Assessments*. The table lists the total number of items per ECS Math form (data is provided for one form for each set of parallel forms) that address each content standard. In addition, the corresponding NRS educational functioning level for each content standard is identified ABE, and ASE. For example, content standard M1.1.1 is: *Associate Numbers with Quantities.* This content standard includes skills associated with NRS ABE educational functioning level 1.

Table e1-4 through e1-15 provides information on the specific competency addressed by each item on each form of the *ECS Math Assessments*. Competencies specifically identify the skills that learners will obtain and be measured on and are aligned to the content standards. They help form the basis of the CASAS integrated assessment and curriculum management system.

M1.1.1 "associate numbers with quantities" is typically taught and mastered at **NRS level 1** in ABE

Contend standard M1.1.1 is assessed in 1 test item in ECS Form 12

		TEST FORMS▶									
		ABE				ASE					
	NRS LEVEL▶	1	2	3	4	5	6	**ECS FORM 11**	**ECS FORM 12**	**ECS FORM 13**	**ECS FORM 14**
	CASAS LEVEL▶	A	B	B	C	D	E				
Content Standards▼											
M1	***Number sense***										
M1.1	*Whole numbers*										
M1.1.1	*associate numbers with quantities*	●							1		
M1.1.2	*count up to 30 items, forward and backward*	●							1		
M1.1.3	*count up to 100 items*	●									

Figure e1-1 Underlying Basic Skills Content Standards

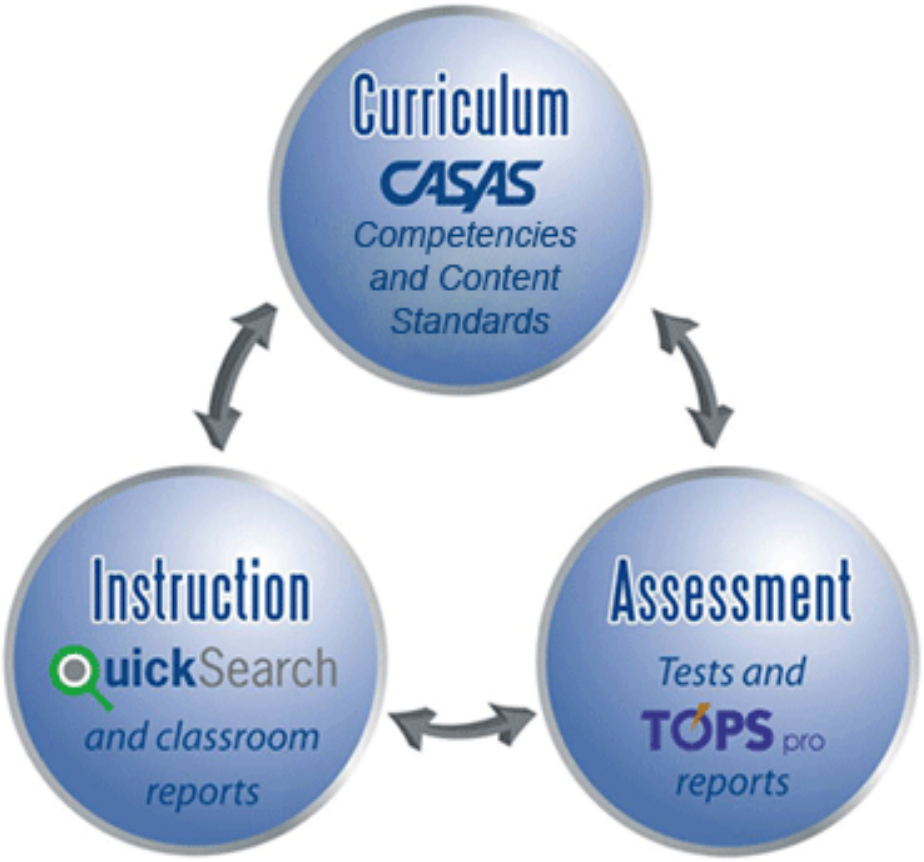


Table e1-1 Comparison of NRS Educational Functioning Level Descriptors and CASAS Level Descriptors for Math – Adult Basic Education (ABE)

Literacy level	Numeracy Skills (NRS)	Functional and Workplace Skills (NRS)	CASAS
Beginning ABE Literacy	Individual has little or no recognition of numbers or simple counting skills or may have only minimal skills, such as the ability to add or subtract single digit numbers.	Individual has little or no ability to read basic signs or maps and can provide limited personal information on simple forms. The individual can handle routine entry level jobs that require little or no basic written communication or computational skills and no knowledge of computers or other technology.	**Beginning Literacy/Pre-Beginning** **Math**: Can read numbers associated with size, quantity, and other basic measurement; can add and subtract two-digit numbers; can recognize correct change in transactions; can calculate with time; can perform most single-digit multiplication **Employability**: Can handle routine entry-level jobs that involve only the most basic oral and written communication and in which all tasks can be demonstrated.
Beginning Basic Education	Individual can count, add, and subtract three digit numbers, can perform multiplication through 12, can identify simple fractions, and perform other simple arithmetic operations.	Individual is able to read simple directions, signs, and maps, fill out simple forms requiring basic personal information, write phone messages, and make simple changes. There is minimal knowledge of and experience with using computers and related technology. The individual can handle basic entry level jobs that require minimal literacy skills; can recognize very short, explicit, pictorial texts (e.g., understands logos related to worker safety before using a piece of machinery); and can read want ads and complete simple job applications	**Beginning Basic Skills** **Math**: Can calculate a single simple operation when numbers are given, and make simple change **Employability**: Can handle entry-level jobs that involve some simple oral and written communication but in which tasks can also be demonstrated and/or clarified orally.

Table e1-1 Comparison of NRS Educational Functioning Level Descriptors and CASAS Level Descriptors for Math– Adult Basic Education (ABE) (cont.)

Literacy level	Numeracy Skills (NRS)	Functional and Workplace Skills (NRS)	CASAS
Low Intermediate Basic Education	Individual can perform with high accuracy all four basic math operations using whole numbers up to three digits and can identify and use all basic mathematical symbols. .	Individual is able to handle basic reading, writing, and computational tasks related to life roles, such as completing medical forms, order forms, or job applications; and can read simple charts, graphs, labels, and payroll stubs and simple authentic material if familiar with the topic. The individual can use simple computer programs and perform a sequence of routine tasks given direction using technology (e.g., fax machine, computer operation). The individual can qualify for entry level jobs that require following basic written instructions and diagrams with assistance, such as oral clarification; can write a short report or message to fellow workers; and can read simple dials and scales and take routine measurements.	**Intermediate Basic Skills** **Math**: Can handle basic computational tasks related to life roles. Can interpret simple charts, graphs, and labels; interpret a basic payroll stub; Can complete a simple order form and do calculations **Employability**: Can handle jobs and/or training that involve following basic oral and written instructions and diagrams if they can be clarified orally.
High Intermediate Basic Education	Individual can perform all four basic math operations with whole numbers and fractions; can determine correct math operations for solving narrative math problems and can convert fractions to decimals and decimals to fractions; and can perform basic operations on fractions.	Individual is able to handle basic life skills tasks such as graphs, charts, and labels and can follow multistep diagrams; can read authentic materials on familiar topics, such as simple employee handbooks and payroll stubs; can complete forms such as a job application and reconcile a bank statement. Can handle jobs that involve following simple written instructions and diagrams; can read procedural texts, where the information is supported by diagrams, to remedy a problem, such as locating a problem with a machine or carrying out repairs using a repair manual. The individual can learn or work with most basic computer software, such as using a word processor to produce own texts, and can follow simple instructions for using technology.	**Advanced Basic Skills** **Math**: Can handle most routine computational tasks related to their life roles; interpret a payroll stub; interpret routine charts, and graphs. Can complete an order form and do calculations; compute tips; reconcile a bank statement; maintain a family budget; **Employability**: Can handle jobs and job training situations that involve following oral and simple written instructions and multi-step diagrams and limited public contact. Can read a simple employee handbook and make simple log entries

Table e1-2 Comparison of NRS Educational Functioning Level Descriptors and CASAS Level Descriptors for Math – Adult Secondary Education (ASE)

Literacy level	Numeracy Skills (NRS)	Functional and Workplace Skills (NRS)	CASAS
Low Adult Secondary Education	Individual can perform all basic math functions with whole numbers, decimals, and fractions; can interpret and solve simple algebraic equations, tables, and graphs and can develop own tables and graphs; and can use math in business transactions.	Individual is able or can learn to follow simple multistep directions and read common legal forms and manuals; can integrate information from texts, charts, and graphs; can create and use tables and graphs; can complete forms and applications and complete resumes; can perform jobs that require interpreting information from various sources and writing or explaining tasks to other workers; is proficient using computers and can use most common computer applications; can understand the impact of using different technologies; and can interpret the appropriate use of new software and technology.	**Adult Secondary** **Math**: Can use math in business, such as calculating discounts; create and use tables and graphs Can create tables that provide for calculation of data. Can apply common practical formulas (e.g., $d = r \times t$). Can plot equations on a graph. Can interpret and calculate rates (e.g., frequency, consumption). Can calculate perimeter, area and volume of a variety of common figures. Can calculate with metric units of measure. **Employability**: Understands routine work-related conversations. Can handle work that involves following oral and simple written instructions and interact with the public. Can perform Math and writing tasks, such as most logs, reports, and forms, with reasonable accuracy to meet work needs.
High Adult Secondary Education	Individual can make mathematical estimates of time and space and can apply principles of geometry to measure angles, lines, and surfaces and can also apply trigonometric functions.	Individual is able to read technical information and complex manuals; can comprehend some college level books and apprenticeship manuals; can function in most job situations involving higher order thinking; can read text and explain a procedure about a complex and unfamiliar work procedure, such as operating a complex piece of machinery; can evaluate new work situations and processes; and can work productively and collaboratively in groups and serve as facilitator and reporter of group work. The individual is able to use common software and learn new software applications; can define the purpose of new technology and software and select appropriate technology; can adapt use of software or technology to new situations; and can instruct others, in written or oral form, on software and technology use.	**Advanced Adult Secondary** **Math**: Can use math in business, such as calculating discounts; create and use tables and graphs; Can interpret data in more complex sorts of graphs and representations. Can summarize and report data for a particular purpose. Can present data in various representations and interpretations. Can apply ratio and proportion. Can create and interpret graphs of more complex equations. Can work with three-dimensional representations and coordinate systems. Can apply and calculate a variety of rates. **Employability**: Can meet work demands with confidence, interact with the public, and follow written instructions in work manuals.

Table e1-3 Math Basic Skills Content Standards by Test Item for CASAS ECS Math Assessments

		TEST FORMS▶						ECS FORM 11	ECS FORM 12	ECS FORM 13	ECS FORM 14	WLS FROM 213	WLS FROM 214	ECS FORM 15	ECS FORM 16	WLS FROM 215	WLS FROM 216	ECS FROM 17	ECS FROM 18
		ABE				ASE													
	NRS LEVEL▶	1	2	3	4	5	6												
	CASAS LEVEL▶	A	B	B	C	D	E												
	Content Standards▼																		
M1	**Number sense**																		
M1.1	Whole numbers																		
M1.1.1	associate numbers with quantities	●							1										
M1.1.2	count up to 30 items, forward and backward	●							1										
M1.1.3	count up to 100 items	●																	
M1.1.4	count by 2s, 5s, and 10s up to 100	●																	
M1.1.5	recognize odd and even numbers	●	●																
M1.1.6	read, write, order and compare numbers from 0 to 100	●	●																
M1.1.7	read, write, order and compare numbers to 1000		●																
M1.1.8	read, write, order and compare numbers to 1,000,000		●	●						1	1								
M1.1.9	read, write, order and compare numbers in the millions and billions		●	●															
M1.1.10	identify place value in numbers to five digits		●	●															
M1.1.11	round off numbers to the nearest 10, 100, 1000		●	●															
M1.2	Operation sense																		
	Concepts																		
M1.2.1	interpret and use basic mathematical symbols +, –, ×, ÷, =	●																	

		TEST FORMS▶						ECS FORM 11	ECS FORM 12	ECS FORM 13	ECS FORM 14	WLS FROM 213	WLS FROM 214	ECS FORM 15	ECS FORM 16	WLS FROM 215	WLS FROM 216	ECS FROM 17	ECS FROM 18
		ABE				ASE													
	NRS LEVEL▶	1	2	3	4	5	6												
	CASAS LEVEL▶	A	B	B	C	D	E												
	Content Standards▼																		
M1.2.2	understand the concept of addition (i.e., as adding on or combining), including the role of place value	•	•																
M1.2.3	understand the concept of subtraction (i.e., as taking away or separating), including the role of place value	•	•																
M1.2.4	understand the concept of multiplication (i.e., as repeated addition, multiple groups, rows and columns), including the role of place value		•	•															
M1.2.5	understand the concept of division (i.e., as dividing a set into equal groups, or determining number of groups within a set), including the role of place value		•	•															
M1.2.6	understand the inverse relationship between addition and subtraction, and multiplication and division		•	•															
M1.2.7	understand the commutative and associative properties of addition and multiplication (e.g., 2 pounds of meat at $3/lb. costs the same as 3 pounds at $2/lb.)		•	•															
M1.2.8	understand the distributive property (e.g., $150 × 12 = ($150 × 10) + ($150 × 2))			•	•														
	Addition																		
M1.2.9	add single-digit numbers with totals up to 10	•																	
M1.2.10	know addition pairs totaling 10	•																	

		TEST FORMS▶						ECS FORM 11	ECS FORM 12	ECS FORM 13	ECS FORM 14	WLS FROM 213	WLS FROM 214	ECS FORM 15	ECS FORM 16	WLS FROM 215	WLS FROM 216	ECS FROM 17	ECS FROM 18
		ABE				ASE													
	NRS LEVEL▶	1	2	3	4	5	6												
	CASAS LEVEL▶	A	B	B	C	D	E												
	Content Standards▼																		
M1.2.11	know addition pairs for all numbers up to 10	•																	
M1.2.12	add three or more single-digit numbers mentally	•	•																
M1.2.13	add two or three-digit numbers	•	•							2	1	2	3						
	Subtraction																		
M1.2.14	subtract single-digit numbers	•								2									
M1.2.15	subtract single-digit numbers from numbers up to 20	•																	
M1.2.16	subtract two or three-digit numbers	•	•								1	2	2			1	1		
M1.2.17	add back to check subtraction	•	•																
	Multiplication																		
M1.2.18	multiply single-digit numbers	•																	
M1.2.19	double numbers up to 10	•																	
M1.2.20	know multiples of 2, 3, 4, 5, 10 up to ×10		•																
M1.2.21	know multiplication facts for numbers to 12		•	•															
M1.2.22	multiply numbers by 10, 100		•	•												1			
M1.2.23	multiply two-digit numbers by single-digit numbers		•	•															
M1.2.24	multiply with numbers of two or more digits		•	•							1	1	1	1		1			
M1.2.25	square numbers to 12		•	•											1				
	Division																		
M1.2.26	halve even numbers up to 20	•	•																

		TEST FORMS▶						ECS FORM 11	ECS FORM 12	ECS FORM 13	ECS FORM 14	WLS FROM 213	WLS FROM 214	ECS FORM 15	ECS FORM 16	WLS FROM 215	WLS FROM 216	ECS FROM 17	ECS FROM 18
		ABE				ASE													
	NRS LEVEL▶	1	2	3	4	5	6												
	CASAS LEVEL▶	A	B	B	C	D	E												
	Content Standards▼																		
M1.2.27	halve even numbers up to 100		●	●															
M1.2.28	identify factoring of common numbers (e.g., 12 = 4 × 3 = 2 × 6 = 2 × 2 × 3)		●	●															
M1.2.29	identify factors of numbers up to 100 (e.g., 72 is divisible by 1, 2, 3, 4, 6, …)		●	●	●														
M1.2.30	identify the greatest common factor in a given number set			●	●														
M1.2.31	divide numbers by 10, 100		●	●															
M1.2.32	express a remainder in long division as a fraction		●	●															
M1.2.33	divide two-digit numbers by single-digit numbers and interpret remainders		●	●															
M1.2.34	divide by numbers of two or more digits and interpret remainders			●	●					1	1	1					3		
M1.2.35	back-multiply to check results of division		●	●	●														
M1.2.36	identify prime numbers up to 100			●	●														
M1.3	Fractions																		
M1.3.1	understand, name and write fractions as representing portions of an object or set	●	●									1	1						
M1.3.2	read and write simple common fractions (e.g., halves, quarters, thirds)	●	●																
M1.3.3	compare and order simple common fractions	●	●																
M1.3.4	understand how fractions relate to multiples and		●	●												1			

		TEST FORMS▶						ECS FORM 11	ECS FORM 12	ECS FORM 13	ECS FORM 14	WLS FROM 213	WLS FROM 214	ECS FORM 15	ECS FORM 16	WLS FROM 215	WLS FROM 216	ECS FROM 17	ECS FROM 18
		ABE				ASE													
	NRS LEVEL▶	1	2	3	4	5	6												
	CASAS LEVEL▶	A	B	B	C	D	E												
	Content Standards▼																		
	division (e.g., divide these 12 into 3 parts; 1/3 of 12 is 4, 2/3 is 8)																		
M1.3.5	divide an object or set into fractional pieces (e.g., cut a cake into 12 equal pieces)	●	●													1	1		
M1.3.6	understand equivalent fractions and simplify fractions to lowest terms			●	●											1			
M1.3.7	express a relation between two quantities as a fraction or fractional estimate (54 of 352 graduates = 54/352; or about 1/6)			●	●														1
M1.3.8	add and subtract common fractions with the same denominator		●	●								1	1			1			
M1.3.9	convert improper fractions and mixed numbers			●	●							1	1						
M1.3.10	add and subtract fractions and mixed numbers with different denominators			●	●					2	2					2	4	1	1
M1.3.11	relate multiplication of fractions and division (i.e., multiplying by 1/4 is equivalent to dividing by 4)			●	●													1	1
M1.3.12	multiply and divide with fractions and mixed numbers			●	●							2	2					4	3
M1.3.13	represent decimals as fractions			●	●														
M1.3.14	use fractions in the context of measurement units	●	●	●	●													1	
M1.4	Decimals																		
M1.4.1	understand decimal notation and place value		●	●														3	2

		TEST FORMS▶						ECS FORM 11	ECS FORM 12	ECS FORM 13	ECS FORM 14	WLS FROM 213	WLS FROM 214	ECS FORM 15	ECS FORM 16	WLS FROM 215	WLS FROM 216	ECS FROM 17	ECS FROM 18
		ABE				ASE													
	NRS LEVEL▶	1	2	3	4	5	6												
	CASAS LEVEL▶	A	B	B	C	D	E												
	Content Standards▼																		
M1.4.2	read and write decimals to two decimal places		●	●															
M1.4.3	express simple common fractions as decimals		●	●	●												1		
M1.4.4	read, write, order and compare decimals of three or more places		●	●	●													3	2
M1.4.5	divide whole numbers and represent quotient as a decimal			●	●													2	1
M1.4.6	round decimal amounts to one or two decimal places or to a whole number			●	●							1	1			2	2		
M1.4.7	add, subtract, multiply and divide decimals			●	●			2	2	10	12	7	6	11	10	5	5	10	9
M1.4.8	know the effect of multiplying and dividing decimals by powers of 10			●	●														
M1.4.9	read and write large numbers with decimals (e.g., 15.6 million)			●	●														
M1.4.10	convert fractions to decimals		●	●	●														
M1.4.11	determine a fraction or percent of a decimal (e.g., ¼ / 25% of the $8.3 million budget)			●	●														
M1.4.12	use decimals in the context of measurement units		●	●	●					2	1			1				7	6
M1.4.13	relate the decimal system with money		●	●	●			1		1	1	1	2						
M1.4.14	read and write money amounts using decimals and symbols $ and ¢			●	●			6	6	1									
M1.4.15	make and verify change		●	●	●			2	2	1	1	1	1						
M1.4.16	calculate with money amounts	●	●	●	●			3	2	7	9	6	7	15	14	6	6		3

		TEST FORMS▶						ECS FORM 11	ECS FORM 12	ECS FORM 13	ECS FORM 14	WLS FROM 213	WLS FROM 214	ECS FORM 15	ECS FORM 16	WLS FROM 215	WLS FROM 216	ECS FROM 17	ECS FROM 18
		ABE				ASE													
	NRS LEVEL▶	1	2	3	4	5	6												
	CASAS LEVEL▶	A	B	B	C	D	E												
	Content Standards▼																		
M1.4.17	use currency conversion tables				●														
M1.5	Percentages																		
M1.5.1	understand the meaning of percent			●	●									2					
M1.5.2	read, write, order and compare simple percentages			●	●									2					
M1.5.3	compute mentally 10% and 1% of an amount			●	●										1				
M1.5.4	know percent equivalents for simple common fractions			●	●											1			
M1.5.5	represent decimal amounts as percents			●	●														1
M1.5.6	find benchmark percents of numbers to 1000 (e.g., 10%, 25%, 50%)			●	●							1		1	3			1	
M1.5.7	find a given percent of a number			●	●							2	2	2	4	4	5		1
M1.5.8	find the whole from a given percentage				●											1			
M1.5.9	calculate percents to one or two decimal places				●							1	1	3	1				
M1.5.10	understand and calculate percents greater than 100% and less than 1%				●														
M1.5.11	calculate percent of increase and decrease				●													1	1
M1.5.12	apply percents to money, measurement, and other contextual situations			●	●					1	1	3	2	5	5	1	1	5	5
M1.6	Ratio and proportion																		
M1.6.1	identify quantities that are proportional			●	●	●												2	
M1.6.2	understand the meaning of ratio			●	●	●													

		TEST FORMS▶						ECS FORM 11	ECS FORM 12	ECS FORM 13	ECS FORM 14	WLS FROM 213	WLS FROM 214	ECS FORM 15	ECS FORM 16	WLS FROM 215	WLS FROM 216	ECS FROM 17	ECS FROM 18
		ABE				ASE													
	NRS LEVEL▶	1	2	3	4	5	6												
	CASAS LEVEL▶	A	B	B	C	D	E												
	Content Standards▼																		
M1.6.3	express a relationship between two quantities as a ratio			●	●	●													1
M1.6.4	write and solve a proportion				●	●						1	1			2	2		2
M1.6.5	apply ratio and proportion in contextual situations using ratios				●	●	●					2	2			2	3		1
M1.7	Solving problems																		
M1.7.1	analyze a math-related situation or problem, identifying the mathematical question that needs to be answered, the most appropriate methods, procedures, algorithms and operations to apply, and the relevant and irrelevant information	●	●	●	●	●	●	2	2	9	10	11	11	16	19	15	12	11	11
M1.7.2	perform operations efficiently and correctly	●	●	●	●	●	●							16	18				
M1.7.3	apply estimation strategies and mental math to approximate solutions and determine reasonableness of answers		●	●	●	●	●			1		2	2	2		2	1		
M1.7.4	determine and use appropriate rounding and estimating techniques		●	●	●	●	●					3	3	2		2	2		
M1.7.5	determine and use a variety of techniques and processes for doing mental math		●	●	●	●	●							4					
M1.7.6	recognize the degree of precision needed in a calculation			●	●	●	●												
M1.7.7	determine when and how to split up a problem into simpler parts			●	●	●	●					2	2			7	7		
M1.7.8	apply strategies and results from simpler problems to more complex problems			●	●	●	●												

		TEST FORMS▶						ECS FORM 11	ECS FORM 12	ECS FORM 13	ECS FORM 14	WLS FROM 213	WLS FROM 214	ECS FORM 15	ECS FORM 16	WLS FROM 215	WLS FROM 216	ECS FROM 17	ECS FROM 18
		ABE				ASE													
	NRS LEVEL▶	1	2	3	4	5	6												
	CASAS LEVEL▶	A	B	B	C	D	E												
	Content Standards▼																		
M1.8	Using a calculator																		
M1.8.1	use a calculator to make basic calculations with +, –, ×, ÷, =		●	●												1	1		
M1.8.2	order or reorder operations when grouping is important to achieve correct results with a calculator (e.g., 10 – 2 × 6 instead of 6 × 10 – 2)			●	●	●													
M1.8.3	use a calculator to make calculations involving multiple operations or percent			●	●	●	●												
M1.8.4	use a calculator for more advanced calculations				●	●	●												
M2	**Algebra**																		
M2.1	Patterns, relationships, functions																		1
M2.1.1	recognize the numerical patterns and relationships inherent in the addition and multiplication tables	●	●	●															
M2.1.2	recognize and describe patterns in given sets of numbers in a functional relationship and how changes in one quantity can affect another			●	●														
M2.2	Basic algebraic concepts and conventions																		
M2.2.1	understand mathematical expressions and equations as symbolic representation, including the concept of a variable		●	●	●														
M2.2.2	understand what it means to solve an equation			●	●	●													
M2.2.3	reason mathematically regarding contextual situations			●	●	●												3	2

		TEST FORMS▶						ECS FORM 11	ECS FORM 12	ECS FORM 13	ECS FORM 14	WLS FROM 213	WLS FROM 214	ECS FORM 15	ECS FORM 16	WLS FROM 215	WLS FROM 216	ECS FROM 17	ECS FROM 18
		ABE				ASE													
	NRS LEVEL▶	1	2	3	4	5	6												
	CASAS LEVEL▶	A	B	B	C	D	E												
	Content Standards▼																		
M2.2.4	interpret and write expressions and equations for simple contextual math situations			●	●	●												1	
M2.2.5	know and use the correct order of operations			●	●														
M2.2.6	know and use notational conventions such as parentheses and the various ways of representing multiplication				●	●												1	1
M2.2.7	interpret symbols <, >, ≠ and use to express number relationships			●	●	●													
M2.3	Unknowns, equations and expressions																		
M2.3.1	understand and solve simple one-step equations with unknowns (e.g., n – 7 = 9; 3x = 24)			●	●	●												1	1
M2.3.2	use substitution to check the solution of an equation			●	●	●													
M2.3.3	understand the different meanings and uses of variables (i.e., 2x + 1 = 7; y = 2x + 1; A = l × w; a + –a = 0)				●	●													
M2.3.4	substitute values for variables in simple expressions and evaluate				●	●													
M2.3.5	simplify an expression by combining like terms				●	●													
M2.3.6	apply the commutative and associative properties of addition and multiplication to rewrite expressions				●	●													
M2.3.7	apply the distributive property to rewrite expressions (e.g., 3(x + 2) vs. 3x + 6)				●	●													

		TEST FORMS▶						ECS FORM 11	ECS FORM 12	ECS FORM 13	ECS FORM 14	WLS FROM 213	WLS FROM 214	ECS FORM 15	ECS FORM 16	WLS FROM 215	WLS FROM 216	ECS FROM 17	ECS FROM 18
		ABE				ASE													
	NRS LEVEL▶	1	2	3	4	5	6												
	CASAS LEVEL▶	A	B	B	C	D	E												
	Content Standards▼																		
M2.3.8	use the additive and multiplicative properties of equality to solve linear equations and write equivalent equations				●	●													
M2.3.9	make mathematical arguments (e.g., proofs) using properties of real numbers and operations					●	●												
M2.3.10	interpret and write expressions and equations representing contextual situations				●	●	●												
M2.3.11	interpret or write an expression or equation for a contextual situation that involves fractions, decimals or percents			●	●	●	●											3	3
M2.3.12	solve problems involving life-skill-related formulas (e.g., units × price = cost; d = r × t)			●	●	●	●												
M2.3.13	solve problems involving technical formulas (e.g., V = I × R)				●	●	●											2	2
M2.3.14	solve inequalities				●	●	●												
M2.3.15	solve systems of linear equations				●	●	●												
M2.3.16	know, understand and apply the Pythagorean theorem				●	●	●											2	1
M2.3.17	solve quadratic equations				●	●	●												
M2.3.18	understand algebraic concepts and terminology used at secondary level					●	●												
M2.4	Exponents and numbers																		
M2.4.1	interpret and use exponents as representing repeated multiplication			●	●	●													

		TEST FORMS▶						ECS FORM 11	ECS FORM 12	ECS FORM 13	ECS FORM 14	WLS FROM 213	WLS FROM 214	ECS FORM 15	ECS FORM 16	WLS FROM 215	WLS FROM 216	ECS FROM 17	ECS FROM 18
		ABE				ASE													
	NRS LEVEL▶	1	2	3	4	5	6												
	CASAS LEVEL▶	A	B	B	C	D	E												
	Content Standards▼																		
M2.4.2	rewrite expressions using exponents				●	●													
M2.4.3	add, subtract, multiply and divide expressions involving exponents				●	●													
M2.4.4	understand, interpret and use scientific notation				●	●													
M2.5	Positive and negative numbers																		
M2.5.1	understand the meaning and uses of negative numbers				●	●												1	
M2.5.2	read, write, order and compare positive and negative numbers				●														
M2.5.3	place positive and negative numbers on a number line, and relate them to direction and change				●														
M2.5.4	add, subtract, multiply and divide positive and negative numbers				●													1	1
M2.5.5	understand and use absolute value				●	●													
M2.6	Representations																		
M2.6.1	understand and relate different representations of functions: words, symbols, tables, graphs			●	●	●	●												
M2.6.2	generate a table of values from an equation in two variables				●	●	●												
M2.6.3	understand the Cartesian coordinate system				●	●													
M2.6.4	create a coordinate plane, drawing and labeling x and y axes and scale				●	●	●												

		TEST FORMS▶						ECS FORM 11	ECS FORM 12	ECS FORM 13	ECS FORM 14	WLS FROM 213	WLS FROM 214	ECS FORM 15	ECS FORM 16	WLS FROM 215	WLS FROM 216	ECS FROM 17	ECS FROM 18
		ABE				ASE													
	NRS LEVEL▶	1	2	3	4	5	6												
	CASAS LEVEL▶	A	B	B	C	D	E												
	Content Standards▼																		
M2.6.5	plot ordered pairs from an equation or data table				●	●	●												
M2.6.6	identify points and their coordinates on a graph of an equation				●	●	●												
M2.6.7	determine the slope of a line and relate it to change				●	●	●												
M2.6.8	use a graph to answer questions about a functional relationship			●	●	●	●												
M2.6.9	write the equation of a line				●	●	●												
M2.6.10	plot more than one equation on the same plane				●	●													
M2.6.11	graph a linear function				●	●													
M2.6.12	graph quadratic functions					●	●												
M3	**Geometry**																		
M3.1	Shapes																		
M3.1.1	recognize, name and describe the properties of common two-dimensional and three-dimensional geometric shapes	●	●	●	●														
M3.1.2	identify lines of symmetry in two-dimensional figures		●	●	●														
M3.1.3	draw two-dimensional shapes of particular dimensions		●	●	●													2	
M3.1.4	identify triangles based on their properties			●	●	●													
M3.1.5	identify common types of quadrilaterals and their properties			●	●	●													

		TEST FORMS▶						ECS FORM 11	ECS FORM 12	ECS FORM 13	ECS FORM 14	WLS FROM 213	WLS FROM 214	ECS FORM 15	ECS FORM 16	WLS FROM 215	WLS FROM 216	ECS FROM 17	ECS FROM 18
		ABE				ASE													
	NRS LEVEL▶	1	2	3	4	5	6												
	CASAS LEVEL▶	A	B	B	C	D	E												
	Content Standards▼																		
M3.1.6	identify polygons of various types			●	●	●													
M3.1.7	identify elements of a circle: center, radius, diameter, arc			●	●	●													
M3.1.8	understand concepts of similarity, and identify figures that are similar or congruent				●	●													
M3.2	Lines and angles																		
M3.2.1	identify parallel, perpendicular and intersecting lines			●	●	●													
M3.2.2	describe characteristics of angles formed by two intersecting lines			●	●	●													
M3.2.3	describe characteristics of angles formed by a transversal intersecting parallel lines				●	●													
M3.2.4	understand the 360-degree system of measuring angles and rotation			●	●	●													
M3.2.5	identify angles of 90 and 45 degrees			●															
M3.2.6	identify rotations of 90, 180, 270 and 360 degrees			●	●	●													
M3.2.7	identify angles as right, acute, obtuse			●	●	●													
M3.2.8	measure an angle using a protractor			●	●	●													
M3.2.9	estimate the measure of an angle			●	●	●													
M3.2.10	draw angles of specific measures			●	●	●													
M3.2.11	using a protractor and ruler			●	●	●													
M3.3	Spatial relationships																		

		TEST FORMS▶						ECS FORM 11	ECS FORM 12	ECS FORM 13	ECS FORM 14	WLS FROM 213	WLS FROM 214	ECS FORM 15	ECS FORM 16	WLS FROM 215	WLS FROM 216	ECS FROM 17	ECS FROM 18
		ABE				ASE													
	NRS LEVEL▶	1	2	3	4	5	6												
	CASAS LEVEL▶	A	B	B	C	D	E												
	Content Standards▼																		
M3.3.1	use the four main compass directions for spatial orientation		●	●	●														
M3.3.2	use the secondary directions for spatial orientation (e.g., NW)		●	●	●														
M3.3.3	use a map with a coordinate grid (e.g., C5)			●	●														
M3.3.4	interpret diagrams (e.g., floor plan, blueprint)			●	●										1	1	1	5	6
M3.3.5	draw a diagram on a grid using two-dimensional figures to represent the size and location of objects			●	●	●													
M3.3.6	enlarge or reduce a shape, keeping the same proportions				●	●													1
M3.3.7	combine, divide, rotate, reconfigure or transform shapes to create different figures		●	●	●	●													
M3.3.8	locate or position items in a three-dimensional coordinate system (e.g., in a model of a building)				●	●													
M3.3.9	recognize and draw two-dimensional views of three-dimensional objects from different perspectives				●	●													
M3.3.10	create a three-dimensional object from two-dimensional representations			●	●	●													
M3.3.11	follow a pattern or model to produce or reproduce a shape or object		●	●															
M4	**Measurement**																		

		TEST FORMS▶						ECS FORM 11	ECS FORM 12	ECS FORM 13	ECS FORM 14	WLS FROM 213	WLS FROM 214	ECS FORM 15	ECS FORM 16	WLS FROM 215	WLS FROM 216	ECS FROM 17	ECS FROM 18
		ABE				ASE													
	NRS LEVEL▶	1	2	3	4	5	6												
	CASAS LEVEL▶	A	B	B	C	D	E												
	Content Standards▼																		
M4.1	Time																		
M4.1.1	read time from a clock, analog and digital	●						1	1	1	1	1	1	1	1				
M4.1.2	read and record time of day in 12-hour format	●						2	2	2	1	3	3		2	1	1	1	1
M4.1.3	read and record time of day in 24-hour format		●																
M4.1.4	interpret numeric representations of dates	●						1											
M4.1.5	place dates on a time line	●																	
M4.1.6	convert units: hours, minutes, seconds		●	●	●							1	2						
M4.1.7	calculate with units of time: hours, minutes, seconds		●	●	●			1	4	1	1	5	5	1	3	1	1	1	1
M4.1.8	convert and calculate with units of time: hours, days, weeks, months, years			●	●										1		1		
M4.1.9	convert hours and minutes to decimal time format			●	●							1	1					2	2
M4.2	Distance																		
M4.2.1	calculate with miles, feet		●	●															
M4.2.2	convert units: feet, miles			●	●														
M4.2.3	estimate equivalents between feet/miles and meters/kilometers				●														1
M4.2.4	calculate with kilometers, meters				●														
M4.2.5	read mileage tables			●	●														
M4.2.6	apply a scale on a map			●	●					2	2								
M4.2.7	estimate distance		●	●	●														

		TEST FORMS▶						ECS FORM 11	ECS FORM 12	ECS FORM 13	ECS FORM 14	WLS FROM 213	WLS FROM 214	ECS FORM 15	ECS FORM 16	WLS FROM 215	WLS FROM 216	ECS FROM 17	ECS FROM 18
		ABE				ASE													
	NRS LEVEL▶	1	2	3	4	5	6												
	CASAS LEVEL▶	A	B	B	C	D	E												
	Content Standards▼																		
M4.2.8	use scientific notation to express great distances			●	●														
M4.3	Speed																		
M4.3.1	understand the interrelation of distance, time and speed			●	●														
M4.3.2	make simple calculations involving time and distance			●	●														
M4.3.3	make simple calculations of distance and time using a given speed			●	●														
M4.3.4	calculate speed given time and distance				●	●													
M4.3.5	estimate time, distance and speed in traveling				●	●													
M4.3.6	estimate equivalents between mph and km/h				●	●													
M4.4	Rates																		
M4.4.1	understand, interpret, calculate and apply rates involving time, such as velocity (e.g., mi/hr, ft/sec, m/sec), frequency (e.g., calls/hr), consumption (e.g., cal/day, kw/hr), flow (e.g., gal/min), change (e.g., degrees/min, inches/year)				●	●	●									1	1	1	1
M4.4.2	understand, interpret, calculate and apply unit rates (e.g., cents/min, $/sq. ft., mi/gal)				●	●	●			1	1					2	2		
M4.4.3	understand, interpret, calculate and apply other types of rates				●	●	●												
M4.4.4	use averaging in calculating rates				●	●	●										2		
M4.5	Temperature																		

		TEST FORMS▶						ECS FORM 11	ECS FORM 12	ECS FORM 13	ECS FORM 14	WLS FROM 213	WLS FROM 214	ECS FORM 15	ECS FORM 16	WLS FROM 215	WLS FROM 216	ECS FROM 17	ECS FROM 18
		ABE				ASE													
	NRS LEVEL▶	1	2	3	4	5	6												
	CASAS LEVEL▶	A	B	B	C	D	E												
	Content Standards▼																		
M4.5.1	understand Fahrenheit scale, including negative temperatures		●	●	●													1	1
M4.5.2	read temperatures		●	●	●			1	1		2				1				
M4.5.3	compare and calculate with temperatures			●	●	●				2	2			1				1	1
M4.5.4	estimate equivalents between Fahrenheit and Celsius temperatures				●	●													
M4.6	Weight																		
M4.6.1	know customary US units of weight and equivalents: pounds, ounces, tons		●	●	●			1	1					2	1				
M4.6.2	know metric units of weight and equivalents: grams, kilograms, milligrams				●	●													
M4.6.3	convert weight units: pounds, ounces, etc.			●	●					1	1			1	1				
M4.6.4	measure weight using pounds, ounces, etc.			●	●			1	2										
M4.6.5	calculate with pounds, ounces, etc.			●	●									1	1				
M4.6.6	estimate equivalents between customary US and metric units of weight				●	●													
M4.6.7	convert metric units, noting decimal placement: kg/g/mg				●	●													
M4.6.8	measure with metric units of weight				●	●													
M4.6.9	calculate with metric units of weight				●	●				1	1			2	2				
M4.7	Capacity																		
M4.7.1	know customary US units of capacity and equivalents: ounces, quarts, gallons, etc.		●	●	●											1	1		

		TEST FORMS▶						ECS FORM 11	ECS FORM 12	ECS FORM 13	ECS FORM 14	WLS FROM 213	WLS FROM 214	ECS FORM 15	ECS FORM 16	WLS FROM 215	WLS FROM 216	ECS FROM 17	ECS FROM 18
		ABE				ASE													
	NRS LEVEL▶	1	2	3	4	5	6												
	CASAS LEVEL▶	A	B	B	C	D	E												
	Content Standards▼																		
M4.7.2	know metric units of capacity and equivalents: liters, milliliters				●	●		1	2										
M4.7.3	convert units of capacity: ounces, quarts, gallons, etc.			●	●			1	2		1					1	1		
M4.7.4	measure capacity using ounces, quarts, gallons, etc.			●	●														
M4.7.5	calculate with ounces, quarts, gallons, etc.			●	●			1	2							1	1		
M4.7.6	estimate equivalents between customary US and metric units of capacity				●	●						1	1					1	
M4.7.7	convert metric units, noting decimal placement: l/ml				●	●													
M4.7.8	measure with metric units of capacity				●	●													
M4.7.9	calculate with metric units of capacity				●	●						1	1						
M4.8	Dimensions																		
M4.8.1	know customary US units of linear measurement and equivalents: inches, feet, yards		●	●	●				1						1				
M4.8.2	know metric units of linear measurement and equivalents: meters, centimeters, millimeters				●	●													
M4.8.3	convert linear measurement units: inches, feet, etc.			●	●											1			
M4.8.4	measure length, width, height using inches, feet, etc.		●	●	●			1	1										
M4.8.5	know and use equivalents for fractions of an			●	●														

		TEST FORMS▶						ECS FORM 11	ECS FORM 12	ECS FORM 13	ECS FORM 14	WLS FROM 213	WLS FROM 214	ECS FORM 15	ECS FORM 16	WLS FROM 215	WLS FROM 216	ECS FROM 17	ECS FROM 18
		ABE				ASE													
	NRS LEVEL▶	1	2	3	4	5	6												
	CASAS LEVEL▶	A	B	B	C	D	E												
	Content Standards▼																		
	inch (e.g., 6/16 = 3/8)																		
M4.8.6	calculate with inches, feet, etc.			●	●											1	1		
M4.8.7	compare linear measurements, including in decimal notation (e.g., tolerances)				●	●												4	4
M4.8.8	estimate equivalents between customary US and metric units of linear measure				●	●										1	1	3	2
M4.8.9	convert metric units, noting decimal placement: m/cm/mm				●													1	1
M4.8.10	measure with metric units of linear measurement				●	●													
M4.8.11	calculate with metric units of linear measurement				●	●													
M4.8.12	interpret scale drawings				●	●	●											2	2
M4.8.13	interpret and use proportions in solving problems involving dimensions or scale				●	●	●									1	1	3	2
M4.8.14	plan linear spacing in a design (e.g., how many lines of what size can fit on a sign of a certain length)				●	●	●												
M4.9	Multi-dimensional measures																		
M4.9.1	understand concept of two and three-dimensional measurements, square and cubic units			●	●	●						2	2			1	1	1	2
M4.9.2	calculate perimeter of rectangles and other common figures			●	●									1	1				

		TEST FORMS▶						ECS FORM 11	ECS FORM 12	ECS FORM 13	ECS FORM 14	WLS FROM 213	WLS FROM 214	ECS FORM 15	ECS FORM 16	WLS FROM 215	WLS FROM 216	ECS FROM 17	ECS FROM 18
		ABE				ASE													
	NRS LEVEL▶	1	2	3	4	5	6												
	CASAS LEVEL▶	A	B	B	C	D	E												
	Content Standards▼																		
M4.9.3	calculate area of rectangles and other common figures, using a given formula			●	●	●						2	2	1		1	1	1	2
M4.9.4	calculate circumference of a circle, using a given formula				●	●													
M4.9.5	calculate volume and surface area of rectangular and other common shapes, using a given formula				●	●				1	1	1	1					1	1
M4.9.6	calculate area or volume of irregular or composite shapes by dividing the figure into parts				●	●									2		1	2	2
M4.9.7	estimate area of curved shapes				●	●													
M4.9.8	understand the exponential relationship of linear measure, area and volume (e.g., cubic feet vs. cubic yards)					●	●												
M4.9.9	plan a layout (e.g., in what ways how many elements of what size can fit in a given space)				●	●	●									1	1		
M4.9.10	apply measurement in three-dimensional scale modeling					●	●												
M4.10	Estimating measurements																		
M4.10.1	make rough-estimate approximations of measurements		●	●	●														
M4.10.2	relate need for accuracy in a given measurement situation to estimating, in terms of precision, rounding, etc.		●	●	●														
M4.10.3	relate the measure of one object to another (e.g.,		●	●	●														

		TEST FORMS▶						ECS FORM 11	ECS FORM 12	ECS FORM 13	ECS FORM 14	WLS FROM 213	WLS FROM 214	ECS FORM 15	ECS FORM 16	WLS FROM 215	WLS FROM 216	ECS FROM 17	ECS FROM 18
		ABE				ASE													
	NRS LEVEL▶	1	2	3	4	5	6												
	CASAS LEVEL▶	A	B	B	C	D	E												
	Content Standards▼																		
	this is about 3 times as long as that; about 6 of these will fit in there)																		
M4.11	Measurement tools																		
M4.11.1	use non-standard measurement methods (e.g., using an object as a measure)	●	●																
M4.11.2	identify and use the appropriate units, instruments and techniques for measurement tasks		●	●	●	●	●	1	1										
M4.11.3	read and use a ruler or tape measure		●	●				1	1										
M4.11.4	read and use a metric rule		●	●	●														
M4.11.5	read a thermometer		●	●	●			1	1	2	2			1	1				
M4.11.6	read analog and other types of scales, meters and gauges, including various types of units and calibrations			●	●	●	●	1	1			1	1	1	1	1	1		
M4.11.7	read digital scales on measuring devices			●	●	●	●	1	1										
M4.11.8	use specialized measurement tools				●	●	●												
M5	**Data**																		
M5.1	Reading and interpreting data																		
M5.1.1	identify, count and extract data in lists, tables and charts	●	●	●	●	●	●	7	8	6	5	13	13	12	14	8	13	9	8
M5.1.2	interpret data organized in categories and groupings	●	●	●	●	●	●												
M5.1.3	compare and extract information from bar		●	●	●	●	●	2	2	2	2			4	4	2		1	2

		TEST FORMS▶						ECS FORM 11	ECS FORM 12	ECS FORM 13	ECS FORM 14	WLS FROM 213	WLS FROM 214	ECS FORM 15	ECS FORM 16	WLS FROM 215	WLS FROM 216	ECS FROM 17	ECS FROM 18
		ABE				ASE													
	NRS LEVEL▶	1	2	3	4	5	6												
	CASAS LEVEL▶	A	B	B	C	D	E												
	Content Standards▼																		
	graphs, block graphs and circle graphs																		
M5.1.4	extract information from line graphs			●	●	●	●							2	2				
M5.1.5	extract information from other types of graphs or visual representations				●	●	●							1		3	1		
M5.1.6	compare information from multiple plottings on the same plane				●	●	●							1	1				
M5.1.7	interpret and compare data in graphs with different scales					●	●												
M5.2	Analyzing data																		
M5.2.1	identify, extract and analyze pertinent data for a particular purpose	●	●	●	●	●	●												
M5.2.2	reorient, reorganize, reformat data		●	●	●	●	●												
M5.2.3	check for internal accuracy in a data set			●	●	●	●											1	
M5.2.4	find the mean and range for a data set			●	●	●					1				1	2	3	1	1
M5.2.5	find the median and mode for a data set			●	●	●													
M5.2.6	make generalizations about a data set, including recognizing clusters and more/less contrasts and identifying trends				●	●	●												
M5.2.7	compare different samples or groupings (e.g., age, gender) in a data set, or individual to overall or average				●	●	●												
M5.2.8	express data relationships in terms of ratios, fractions or percent (e.g., 3 to 1 ratio; 3 out of 4; 75%)			●	●	●	●												

		TEST FORMS▶						ECS FORM 11	ECS FORM 12	ECS FORM 13	ECS FORM 14	WLS FROM 213	WLS FROM 214	ECS FORM 15	ECS FORM 16	WLS FROM 215	WLS FROM 216	ECS FROM 17	ECS FROM 18
		ABE				ASE													
	NRS LEVEL▶	1	2	3	4	5	6												
	CASAS LEVEL▶	A	B	B	C	D	E												
	Content Standards▼																		
M5.2.9	make observations and draw conclusions based on analysis of data		●	●	●	●	●												
M5.2.10	extrapolate data to make predictions				●	●	●												
M5.2.11	restate, summarize, report data for a particular purpose and audience				●	●	●												
M5.2.12	understand and use the basic language of statistics to describe, communicate and discuss data					●	●											2	1
M5.2.13	use computer programs to assist in compiling and analyzing data				●	●	●												
M5.3	Representing data																		
M5.3.1	collect, label and order numerical information for a particular purpose (e.g., to count and list stock, keep a log, construct a schedule)	●	●	●	●	●	●												
M5.3.2	record numerical information using a tally	●	●	●	●	●													
M5.3.3	sort, group, classify or categorize data	●	●	●	●	●													
M5.3.4	create a table to record and present numerical information		●	●	●	●	●												
M5.3.5	create a table that provides for calculation of data (e.g., units × price; totals, subtotals)			●	●	●	●												
M5.3.6	create a graph or other visual representation of data		●	●	●	●	●												
M5.3.7	present data in different interpretations (e.g., as percentages, difference, change)			●	●	●	●											1	

		TEST FORMS▶						ECS FORM 11	ECS FORM 12	ECS FORM 13	ECS FORM 14	WLS FROM 213	WLS FROM 214	ECS FORM 15	ECS FORM 16	WLS FROM 215	WLS FROM 216	ECS FROM 17	ECS FROM 18
		ABE				ASE													
	NRS LEVEL▶	1	2	3	4	5	6												
	CASAS LEVEL▶	A	B	B	C	D	E												
	Content Standards▼																		
M5.4	Understanding the nature of data																		
M5.4.1	understand what the numbers in a data set represent	●	●	●	●	●	●											3	2
M5.4.2	understand different ways in which data can be identified, organized and formatted	●	●	●	●	●	●											1	1
M5.4.3	note how data can change as certain variables change			●	●	●	●												
M5.4.4	understand how average and median can represent a typical quantity or mid-point benchmark and how the spread of data is a factor			●	●	●	●												
M5.4.5	understand constraints on extending data to make predictions			●	●	●	●												
M5.4.6	recognize when data sets can be viably compared and when they cannot				●	●	●												
M5.4.7	understand concepts and implications of sampling and randomization in surveys				●	●	●												
M5.4.8	understand how selection and presentation of data can be oriented for audience and purpose and can influence perceptions and conclusions					●	●												
M5.4.9	evaluate arguments based on statistical reasoning					●	●												
M6	**Probability**																		
M6.1	Outcomes																		

		TEST FORMS▶						ECS FORM 11	ECS FORM 12	ECS FORM 13	ECS FORM 14	WLS FROM 213	WLS FROM 214	ECS FORM 15	ECS FORM 16	WLS FROM 215	WLS FROM 216	ECS FROM 17	ECS FROM 18
		ABE				ASE													
	NRS LEVEL▶	1	2	3	4	5	6												
	CASAS LEVEL▶	A	B	B	C	D	E												
	Content Standards▼																		
M6.1.1	work out the possible combinations of a number of elements in practical situations (e.g., I have 4 tickets and 6 potential guests)			●	●	●	●												
M6.1.2	work out the possible permutations of a number of elements in practical situations (e.g., ways to sequence tiles of 4 different colors in a pattern)			●	●	●	●												
M6.2	Probability																		
M6.2.1	determine the probability of certain simple events (e.g., in the results of tossing a coin or rolling a die)		●	●	●														
M6.2.2	express the likelihood of an occurrence as a ratio fraction or a percent			●	●													1	1
M6.2.3	determine and compare probabilities of chance events (e.g., winning lottery prizes)				●	●	●												
M6.2.4	identify possible outcomes involving compound events and determine the probability of their occurrence (e.g., rolling one die multiple times)					●	●												
M6.2.5	identify possible outcomes from combinations of events and determine the probability of their occurrence (e.g., of rolling different number combinations and totals with two dice)					●	●												
M6.2.6	understand and evaluate factors and their effects in decreasing or increasing the likelihood of occurrences (e.g., wearing a seat belt lessening chance of injury)					●	●												

Table e1-4 ECS Math Form Competencies – Form 11

ITEM	COMP.	THE LEARNER WILL DEMONSTRATE THE ABILITY TO:
1.	1.1.6-4	Count, convert, and use coins and currency, and recognize symbols such as ($) and (.)
2.	1.1.5-5	Interpret temperatures
3.	2.3.2-2	Identify the months of the year and the days of the week
4.	2.1.6-4	Interpret information about using a pay telephone
5.	2.3.1-5	Interpret clock time
6.	1.1.4-5	Select, compute, or interpret appropriate standard measurement for length, width, perimeter, area, volume, height, or weight
7.	1.1.4-5	"
8.	1.1.4-5	"
9.	1.1.6-3	Count, convert, and use coins and currency, and recognize symbols such as ($) and (.)
10.	1.1.6-3	"
11.	1.1.4-5	Select, compute, or interpret appropriate standard measurement for length, width, perimeter, area, volume, height, or weight
12.	4.2.1-2	Interpret wages, wage deductions, benefits, and timekeeping forms
13.	4.2.1-2	"
14.	1.8.3-2	Interpret interest or interest-earning savings plans
15.	1.8.3-2	"
16.	1.9.3-2	Compute mileage and gasoline consumption
17.	1.9.3-2	"
18.	1.7.5-4	Interpret information to obtain repairs
19.	1.7.5-4	"
20.	1.8.2-1	Interpret the procedures and forms associated with banking services, including writing checks
21.	2.2.4-2	Interpret transportation schedules and fares
22.	1.2.1-4	Interpret advertisements, labels, charts, and price tags in selecting goods and services
23.	1.1.7-5	Identify product containers and interpret weight and volume
24.	1.1.7-5	"

Table e1-5 ECS Math Form Competencies – Form 12

ITEM	COMP.	THE LEARNER WILL DEMONSTRATE THE ABILITY TO:
1.	1.2.1-4	Interpret advertisements, labels, charts, and price tags in selecting goods and services
2.	1.2.1-4	"
3.	1.1.4-5	Select, compute, or interpret appropriate standard measurement for length, width, perimeter, area, volume, height, or weight
4.	2.3.2-2	Identify the months of the year and the days of the week
5.	1.1.4-5	Select, compute, or interpret appropriate standard measurement for length, width, perimeter, area, volume, height, or weight
6.	1.8.2-1	Interpret the procedures and forms associated with banking services, including writing checks
7.	1.1.4-5	Select, compute, or interpret appropriate standard measurement for length, width, perimeter, area, volume, height, or weight
8.	1.1.5-5	Interpret temperatures
9.	1.1.6-4	Count, convert, and use coins and currency, and recognize symbols such as ($) and (.)
10.	1.1.6-4	"
11.	1.1.4-5	Select, compute, or interpret appropriate standard measurement for length, width, perimeter, area, volume, height, or weight
12.	1.1.6-3	Count, convert, and use coins and currency, and recognize symbols such as ($) and (.)
13.	2.3.1-5	Interpret clock time
14.	1.8.3-2	Interpret interest or interest-earning savings plans
15.	1.8.3-2	"
16.	1.9.3-2	Compute mileage and gasoline consumption
17.	1.9.3-2	"
18.	4.2.1-2	Interpret wages, wage deductions, benefits, and timekeeping forms
19.	4.2.1-2	"
20.	1.7.4-4	Interpret maintenance procedures for household appliances and personal possessions
21.	1.7.5-4	Interpret information to obtain repairs
22.	1.1.7-5	Identify product containers and interpret weight and volume
23.	1.1.7-5	"
24.	2.2.4-2	Interpret transportation schedules and fares

Table e1-6 ECS Math Form Competencies – Form 13

ITEM	COMP.	THE LEARNER WILL DEMONSTRATE THE ABILITY TO:
1.	6.2.2-0	Subtract decimal fractions
2.	6.2.1-0	Add decimal fractions
3.	6.2.3-0	Multiply decimal fractions
4.	6.1.4-0	Divide whole numbers
5.	6.3.2-0	Subtract common or mixed fractions
6.	6.3.1-0	Add common or mixed fractions
7.	6.3.3-0	Multiply common or mixed fractions
8.	2.2.4-2	Interpret transportation schedules and fares
9.	2.2.4-2	"
10.	2.3.1-5	Interpret clock time
11.	1.2.1-4	Interpret advertisements, labels, charts, and price tags in selecting goods and services
12.	5.4.3-2	Interpret tax tables
13.	5.4.3-2	"
14.	1.1.6-3	Count, convert, and use coins and currency, and recognize symbols such as ($) and (.)
15.	1.1.6-3	"
16.	1.9.3-3	Compute mileage and gasoline consumption
17.	1.1.6-3	Count, convert, and use coins and currency, and recognize symbols such as ($) and (.)
18.	1.1.7-5	Identify product containers and interpret weight and volume
19.	1.1.7-5	"
20.	1.1.3-2	Interpret maps and graphs
21.	1.1.3-2	"
22.	3.3.2-4	Interpret medicine labels
23.	1.1.5-5	Interpret temperatures
24.	1.1.5-5	"
25.	1.8.2-1	Interpret the procedures and forms associated with banking services, including writing checks
26.	1.8.2-1	"
27.	4.2.1-1	Interpret wages, wage deductions, benefits, and timekeeping forms
28.	1.1.4-5	Select, compute, or interpret appropriate standard measurement for length, width, perimeter, area, volume, height, or weight
29.	5.4.2-2	Compute or define sales tax
30.	1.1.3-2	Interpret maps and graphs
31.	1.1.3-2	"

Table e1-7 ECS Math Form Competencies – Form 14

ITEM	COMP.	THE LEARNER WILL DEMONSTRATE THE ABILITY TO:
1.	6.2.2-0	Subtract decimal fractions
2.	6.2.1-0	Add decimal fractions
3.	6.2.3-0	Multiply decimal fractions
4.	6.1.4-0	Divide whole numbers
5.	6.3.2-0	Subtract common or mixed fractions
6.	6.3.1-0	Add common or mixed fractions
7.	6.3.3-0	Multiply common or mixed fractions
8.	2.2.4-2	Interpret transportation schedules and fares
9.	1.2.1-4	Interpret advertisements, labels, charts, and price tags in selecting goods and services
10.	2.3.1-5	Interpret clock time
11.	5.4.3-2	Interpret tax tables
12.	5.4.3-2	"
13.	1.1.6-3	Count, convert, and use coins and currency, and recognize symbols such as ($) and (.)
14.	1.1.6-3	"
15.	1.1.6-3	"
16.	1.9.3-3	Compute mileage and gasoline consumption
17.	1.1.7-5	Identify product containers and interpret weight and volume
18.	1.1.7-5	"
19.	1.1.3-2	Interpret maps and graphs
20.	1.1.3-2	"
21.	1.1.5-5	Interpret temperatures
22.	1.1.5-5	"
23.	1.8.2-1	Interpret the procedures and forms associated with banking services, including writing checks
24.	1.8.2-1	"
25.	4.2.1-1	Interpret wages, wage deductions, benefits, and timekeeping forms
26.	4.2.1-1	"
27.	5.4.2-2	Compute or define sales tax
28.	3.3.2-4	Interpret medicine labels
29.	1.1.4-5	Select, compute, or interpret appropriate standard measurement for length, width, perimeter, area, volume, height, or weight
30.	1.1.3-2	Interpret maps and graphs
31.	1.1.3-2	"

Table e1-8 ECS Math Form Competencies – Form 213

ITEM	COMP.	THE LEARNER WILL DEMONSTRATE THE ABILITY TO:
1.	6.1.1-0	Add whole numbers
2.	6.1.3-0	Multiply whole numbers
3.	6.2.2-0	Subtract decimal fractions
4.	6.3.1-0	Add common or mixed fractions
5.	6.3.3-0	Multiply common or mixed fractions
6.	2.2.4-3	Interpret transportation schedules and fares
	6.1.5	Perform multiple operations using whole numbers
7.	1.2.2-2	Compare price or quality to determine the best buys for goods and services
	4.4.3	Interpret job-related signs, charts, diagrams, forms, and procedures, and record information on forms, charts, checklists, etc.
	6.2.3	Multiply decimal fractions
8.	1.1.6-3	Count, convert, and use coins and currency, and recognize symbols such as ($) and (.)
	6.2.2	Subtract decimal fractions
9.	4.4.3-2	Interpret job-related signs, charts, diagrams, forms, and procedures, and record information on forms, charts, checklists, etc.
	6.1.2	Subtract whole numbers
10.	4.4.3-2	Interpret job-related signs, charts, diagrams, forms, and procedures, and record information on forms, charts, checklists, etc.
	6.2.3	Multiply decimal fractions
11.	4.4.6-3	Interpret work specifications and quality standards
	6.3.1	Add common or mixed fractions
12.	4.4.6-3	Interpret work specifications and quality standards
	6.4.6	Compute using ratio or proportion
13.	4.5.1-3	Identify common tools, equipment, machines, and materials required for one's job
	6.1.5	Perform multiple operations using whole numbers
14.	4.4.3-2	Interpret job-related signs, charts, diagrams, forms, and procedures, and record information on forms, charts, checklists, etc.
	6.1.5	Perform multiple operations using whole numbers
	6.9.2	Estimate answers
15.	2.3.1-5	Interpret clock time
	6.6.6	Calculate with units of time
16.	4.2.4-2	Interpret employee handbooks, personnel policies, and job manuals
	6.2.2	Subtract decimal fractions
17.	1.3.5-4	Use coupons to purchase goods and services
	6.2.2	Subtract decimal fractions
18.	1.2.3-4	Compute discounts
	6.4.1	Apply a percent to determine amount of discount
19.	2.2.4-2	Interpret transportation schedules and fares
	6.6.6	Calculate with units of time
20.	2.2.4-2	Interpret transportation schedules and fares
	6.6.6	Calculate with units of time
21.	4.4.6-3	Interpret work specifications and quality standards
	1.1.4	Select, compute, or interpret appropriate standard measurement for length, width, perimeter, area, volume, height, or weight
	6.6.2	Recognize, use, and measure linear dimensions, geometric shapes, or angles
	6.3.4	Divide common or mixed fractions
22.	4.5.1-3	Identify common tools, equipment, machines, and materials required for one's job
	6.1.5	Perform multiple operations using whole numbers
	6.9.2	Estimate answers

ITEM	COMP.	THE LEARNER WILL DEMONSTRATE THE ABILITY TO:
23.	4.4.3-5	Interpret job-related signs, charts, diagrams, forms, and procedures, and record information on forms, charts, checklists, etc.
	6.6.3	Measure area and volume of geometric shapes
24.	4.2.1-2	Interpret wages, wage deductions, benefits, and timekeeping forms
	6.6.6	Calculate with units of time
25.	4.2.1-1	Interpret wages, wage deductions, benefits, and timekeeping forms
	6.4.3	Calculate percents
26.	1.1.4-5	Select, compute, or interpret appropriate standard measurement for length, width, perimeter, area, volume, height, or weight
	6.6.3	Measure area and volume of geometric shapes
27.	1.2.1-2	Interpret advertisements, labels, charts, and price tags in selecting goods and services
	6.9.2	Estimate answers
28.	2.6.4-2	Interpret and order from restaurant and fast food menus, and compute related costs
	6.0.4	Determine appropriate operation to apply to a given problem
29.	6.6.4-5	Use or interpret measurement instruments, such as rulers, scales, gauges, and dials
	4.5.1	Identify common tools, equipment, machines, and materials required for one's job
30.	1.1.7-4	Identify product containers and interpret weight and volume
	4.5.1	Identify common tools, equipment, machines, and materials required for one's job
	6.2.4	Divide decimal fractions

Table e1-9 ECS Math Form Competencies – Form 214

ITEM	COMP.	THE LEARNER WILL DEMONSTRATE THE ABILITY TO:
1.	6.1.1-0	Add whole numbers
2.	6.1.3-0	Multiply whole numbers
3.	6.2.2-0	Subtract decimal fractions
4.	6.3.1-0	Add common or mixed fractions
5.	6.3.3-0	Multiply common or mixed fractions
6.	1.7.5-4	Interpret information to obtain repairs
	1.2.1	Interpret advertisements, labels, charts, and price tags in selecting goods and services
	6.2.2	Subtract decimal fractions
7.	4.4.6-3	Interpret work specifications and quality standards
	6.4.6	Compute using ratio or proportion
8.	2.2.4-3	Interpret transportation schedules and fares
	6.1.5	Perform multiple operations using whole numbers
9.	3.5.1-2	Interpret nutritional and related information listed on food labels
	6.1.1	Add whole numbers
10.	2.3.1-5	Interpret clock time
	6.6.6	Calculate with units of time
11.	4.4.6-3	Interpret work specifications and quality standards
	6.3.1	Add common or mixed fractions
12.	1.2.2-2	Compare price or quality to determine the best buys for goods and services
	4.4.3	Interpret job-related signs, charts, diagrams, forms, and procedures, and record information on forms, charts, checklists, etc.
	6.2.2	Subtract decimal fractions
13.	4.2.4-2	Interpret employee handbooks, personnel policies, and job manuals
	6.2.2	Subtract decimal fractions
14.	4.4.3-2	Interpret job-related signs, charts, diagrams, forms, and procedures, and record information on forms, charts, checklists, etc.
	6.2.3	Multiply decimal fractions
15.	4.4.3-2	Interpret job-related signs, charts, diagrams, forms, and procedures, and record information on forms, charts, checklists, etc.
	6.1.2	Subtract whole numbers
16.	4.4.3-2	Interpret job-related signs, charts, diagrams, forms, and procedures, and record information on forms, charts, checklists, etc.
	6.1.5	Perform multiple operations using whole numbers
	6.9.2	Estimate answers
17.	1.2.1-2	Interpret advertisements, labels, charts, and price tags in selecting goods and services
	6.9.2	Estimate answers
18.	1.2.3-4	Compute discounts
	6.4.1	Apply a percent to determine amount of discount
19.	2.2.4-2	Interpret transportation schedules and fares
	6.6.6	Calculate with units of time
20.	2.2.4-2	Interpret transportation schedules and fares
	6.6.6	Calculate with units of time
21.	4.4.6-3	Interpret work specifications and quality standards
	1.1.4	Select, compute, or interpret appropriate standard measurement for length, width, perimeter, area, volume, height, or weight
	6.6.2	Recognize, use, and measure linear dimensions, geometric shapes, or angles

ITEM	COMP.	THE LEARNER WILL DEMONSTRATE THE ABILITY TO:
	6.3.4	Divide common or mixed fractions
22.	4.5.1-3	Identify common tools, equipment, machines, and materials required for one's job
	6.1.5	Perform multiple operations using whole numbers
	6.9.2	Estimate answers
23.	4.2.1-3	Interpret wages, wage deductions, benefits, and timekeeping forms
	6.4.1	Apply a percent to determine amount of discount
24.	4.2.1-2	Interpret wages, wage deductions, benefits, and timekeeping forms
	6.6.6	Calculate with units of time
25.	4.2.1-1	Interpret wages, wage deductions, benefits, and timekeeping forms
	6.4.3	Calculate percents
26.	1.1.4-5	Select, compute, or interpret appropriate standard measurement for length, width, perimeter, area, volume, height, or weight
	6.6.3	Measure area and volume of geometric shapes
27.	4.4.3-5	Interpret job-related signs, charts, diagrams, forms, and procedures, and record information on forms, charts, checklists, etc.
	6.6.3	Measure area and volume of geometric shapes
28.	1.1.4-4	Select, compute, or interpret appropriate standard measurement for length, width, perimeter, area, volume, height, or weight
	1.2.1	Interpret advertisements, labels, charts, and price tags in selecting goods and services
	6.2.3	Multiply decimal fractions
29.	6.6.4-5	Use or interpret measurement instruments, such as rulers, scales, gauges, and dials
	4.5.1	Identify common tools, equipment, machines, and materials required for one's job
30.	1.1.7-4	Identify product containers and interpret weight and volume
	4.5.1	Identify common tools, equipment, machines, and materials required for one's job
	6.2.4	Divide decimal fractions

Table e1-10 ECS Math Form Competencies – Form 15

ITEM	COMP.	THE LEARNER WILL DEMONSTRATE THE ABILITY TO:
1.	4.1.3-2	Identify and use sources of information about job opportunities such as job descriptions, job ads, and announcements, and about the workforce and job market
2.	4.1.3-2	"
3.	3.2.3-2	Interpret information associated with medical, dental, or life insurance
4.	1.3.4-2	Use catalogs, order forms, and related information to purchase goods and services
5.	1.3.4-2	"
6.	4.2.1-1	Interpret wages, wage deductions, benefits, and timekeeping forms
7.	4.2.1-1	"
8.	1.1.3-2	Interpret maps and graphs
9.	1.1.3-2	"
10.	4.2.1-2	Interpret wages, wage deductions, benefits, and timekeeping forms
11.	4.2.1-2	"
12.	2.3.1-5	
13.	1.1.4-5	Select, compute, or interpret appropriate standard measurement for length, width, perimeter, area, volume, height, or weight
14.	3.3.2-4	Interpret medicine labels
15.	3.3.2-4	"
16.	1.8.2-1	Interpret the procedures and forms associated with banking services, including writing checks
17.	1.8.1-1	Demonstrate the use of savings and checking accounts, including using an ATM
18.	4.1.3-2	Identify and use sources of information about job opportunities such as job descriptions, job ads, and announcements, and about the workforce and job market
19.	4.1.3-2	"
20.	4.1.3-2	"
21.	1.1.5-5	Interpret temperatures
22.	4.4.3-5	Interpret job-related signs, charts, diagrams, forms, and procedures, and record information on forms, charts, checklists, etc.
23.	4.4.3-2	"
24.	4.4.3-2	"
25.	1.2.2-4	Compare price or quality to determine the best buys for goods and services
26.	1.2.2-4	"
27.	4.2.1-1	Interpret wages, wage deductions, benefits, and timekeeping forms
28.	4.2.1-1	"
29.	4.2.1-1	"
30.	5.4.1-1	Interpret income tax forms
31.	1.1.4-5	Select, compute, or interpret appropriate standard measurement for length, width, perimeter, area, volume, height, or weight

Table e1-11 ECS Math Form Competencies – Form 16

ITEM	COMP.	THE LEARNER WILL DEMONSTRATE THE ABILITY TO:
1.	1.1.3-2	Interpret maps and graphs
2.	1.1.3-2	"
3.	1.3.4-2	Use catalogs, order forms, and related information to purchase goods and services
4.	1.3.4-2	"
5.	1.1.5-5	Interpret temperatures
6.	2.3.1-5	Interpret clock time
7.	4.4.3-5	Interpret job-related signs, charts, diagrams, forms, and procedures, and record information on forms, charts, checklists, etc.
8.	3.3.2-4	Interpret medicine labels
9.	3.3.2-4	"
10.	4.2.1-2	Interpret wages, wage deductions, benefits, and timekeeping forms
11.	4.2.1-2	"
12.	1.8.2-1	Interpret the procedures and forms associated with banking services, including writing checks
13.	1.8.1-1	Demonstrate the use of savings and checking accounts, including using an ATM
14.	4.1.3-2	Identify and use sources of information about job opportunities such as job descriptions, job ads, and announcements, and about the workforce and job market
15.	4.1.3-2	"
16.	1.1.4-5	
17.	5.4.1-1	Interpret income tax forms
18.	4.2.1-1	Interpret wages, wage deductions, benefits, and timekeeping forms
19.	4.2.1-1	"
20.	4.2.1-1	"
21.	3.2.3-2	Interpret information associated with medical, dental, or life insurance
22.	3.2.3-2	"
23.	4.4.3-2	Interpret job-related signs, charts, diagrams, forms, and procedures, and record information on forms, charts, checklists, etc.
24.	4.4.3-2	"
25.	4.1.8-2	Identify common occupations and the skills and education required for them
26.	4.1.8-2	"
27.	4.2.1-1	Interpret wages, wage deductions, benefits, and timekeeping forms
28.	4.2.1-1	"
29.	1.2.2-4	Compare price or quality to determine the best buys for goods and services
30.	1.2.2-4	"
31.	1.1.4-5	Select, compute, or interpret appropriate standard measurement for length, width, perimeter, area, volume, height, or weight

Table e1-12 ECS Math Form Competencies – Form 215

ITEM	COMP.	THE LEARNER WILL DEMONSTRATE THE ABILITY TO:
1.	6.2.2-0	Subtract decimal fractions
2.	6.2.3-0	Multiply decimal fractions
3.	6.3.1-0	Add common or mixed fractions
4.	6.3.2-0	Subtract common or mixed fractions
5.	6.4.2-0	Apply a percent in a context not involving money
6.	6.3.6-0	Convert common or mixed fractions to decimal fractions or percents
7.	1.2.1-2	Interpret advertisements, labels, charts, and price tags in selecting goods and services
	4.4.3	Interpret job-related signs, charts, diagrams, forms, and procedures, and record information on forms, charts, checklists, etc.
	6.1.1	Add whole numbers
8.	1.2.2-2	Compare price or quality to determine the best buys for goods and services
	1.2.1	Interpret advertisements, labels, charts, and price tags in selecting goods and services
	4.4.3	Interpret job-related signs, charts, diagrams, forms, and procedures, and record information on forms, charts, checklists, etc.
	6.1.1	Add whole numbers
9.	1.1.7-5	Identify product containers and interpret weight and volume
	1.1.4	Select, compute, or interpret appropriate standard measurement for length, width, perimeter, area, volume, height, or weight
	6.6.1	Convert units of U.S. standard measurement and metric system
10.	4.7.1-3	Interpret or prepare a work-related budget, including projecting costs, keeping detailed records, and tracking status of expenditures and revenue
	6.0.4	Determine appropriate operation to apply to a given problem
	6.0.5	Demonstrate use of a calculator
11.	1.1.4-5	Select, compute, or interpret appropriate standard measurement for length, width, perimeter, area, volume, height, or weight
	6.6.5	Interpret diagrams, illustrations, and scale drawings
12.	4.2.1-2	Interpret wages, wage deductions, benefits, and timekeeping forms
	6.6.6	Calculate with units of time
13.	5.4.2-2	Compute or define sales tax
	6.4.1	Apply a percent to determine amount of discount
14.	6.6.4-5	Use or interpret measurement instruments, such as rulers, scales, gauges, and dials
	4.5.1	Identify common tools, equipment, machines, and materials required for one's job
15.	1.1.4-5	Select, compute, or interpret appropriate standard measurement for length, width, perimeter, area, volume, height, or weight
	6.6.3	Measure area and volume of geometric shapes
16.	4.4.3-5	Interpret job-related signs, charts, diagrams, forms, and procedures, and record information on forms, charts, checklists, etc.
	6.6.7	Solve measurement problems in stipulated situations
	6.6.2	Recognize, use, and measure linear dimensions, geometric shapes, angles
17.	1.2.2-2	Compare price or quality to determine the best buys for goods and services
	4.4.3	Interpret job-related signs, charts, diagrams, forms, and procedures, and record information on forms, charts, checklists, etc.
	6.2.5	Perform multiple operations using decimal fractions
18.	1.1.1-3	Interpret recipes
	6.4.6	Compute using ratio or proportion
19.	1.1.8-3	Compute averages

ITEM	COMP.	THE LEARNER WILL DEMONSTRATE THE ABILITY TO:
	1.9.3	Compute mileage and gasoline consumption
	6.7.5	Compute averages, medians, or modes
20.	1.3.3-3	Identify or use various methods to purchase goods and services, and make returns and exchanges
	6.2.5	Perform multiple operations using decimal fractions
21.	4.5.1-3	Identify common tools, equipment, machines, and materials required for one's job
	6.6.2	Recognize, use, and measure linear dimensions, geometric shapes, or angles
22.	4.2.1-2	Interpret wages, wage deductions, benefits, and timekeeping forms
	6.2.5	Perform multiple operations using decimal fractions
23.	4.4.3-2	Interpret job-related signs, charts, diagrams, forms, and procedures, and record information on forms, charts, checklists, etc.
	6.7.2	Interpret data given in a bar graph
	6.7.5	Compute averages, medians, or modes
24.	4.4.3-2	Interpret job-related signs, charts, diagrams, forms, and procedures, and record information on forms, charts, checklists, etc.
	6.7.2	Interpret data given in a bar graph
25.	1.2.1-2	Interpret advertisements, labels, charts, and price tags in selecting goods and services
	6.2.5	Perform multiple operations using decimal fractions
26.	4.4.3-2	Interpret job-related signs, charts, diagrams, forms, and procedures, and record information on forms, charts, checklists, etc.
	4.4.6	Interpret work specifications and quality standards
	6.3.1	Add common or mixed fractions
27.	4.4.3-2	Interpret job-related signs, charts, diagrams, forms, and procedures, and record information on forms, charts, checklists, etc.
	6.4.5	Use rate to compute increase or decrease
28.	4.4.6-2	Interpret work specifications and quality standards
	4.4.3	Interpret job-related signs, charts, diagrams, forms, and procedures, and record information on forms, charts, checklists, etc.
	6.4.6	Compute using ratio or proportion
29.	1.5.3-2	Interpret bills
	6.4.1	Apply a percent to determine amount of discount
30.	6.6.1-3	Convert units of U.S. standard measurement and metric system
31.	4.7.3-3	Identify or demonstrate effective management of material resources, including acquisition, storage, and distribution
	6.6.6	Calculate with units of time
	6.4.2	Apply a percent in a context not involving money
32.	4.2.1-3	Interpret wages, wage deductions, benefits, and timekeeping forms
	6.4.1	Apply a percent to determine amount of discount

Table e1-13 ECS Math Form Competencies – Form 216

ITEM	COMP.	THE LEARNER WILL DEMONSTRATE THE ABILITY TO:
1.	6.2.2-0	Subtract decimal fractions
2.	6.2.4-0	Divide decimal fractions
3.	6.3.1-0	Add common or mixed fractions
4.	6.3.2-0	Subtract common or mixed fractions
5.	6.4.2-0	Apply a percent in a context not involving money
6.	6.3.6-0	Convert common or mixed fractions to decimal fractions or percents
7.	1.2.1-2	Interpret advertisements, labels, charts, and price tags in selecting goods and services
	6.2.5	Perform multiple operations using decimal fractions
8.	4.7.1-3	Interpret or prepare a work-related budget, including projecting costs, keeping detailed records, and tracking status of expenditures and revenue
	6.0.4	Determine appropriate operation to apply to a given problem
	6.0.5	Demonstrate use of a calculator
9.	4.2.1-2	Interpret wages, wage deductions, benefits, and timekeeping forms
	6.6.6	Calculate with units of time
10.	4.4.3-2	Interpret job-related signs, charts, diagrams, forms, and procedures, and record information on forms, charts, checklists, etc.
	6.1.1	Add whole numbers
11.	4.4.3-2	Interpret job-related signs, charts, diagrams, forms, and procedures, and record information on forms, charts, checklists, etc.
	6.1.1	Add whole numbers
12.	5.4.2-2	Compute or define sales tax
	6.4.1	Apply a percent to determine amount of discount
13.	6.6.4-5	Use or interpret measurement instruments, such as rulers, scales, gauges, and dials
	4.5.1	Identify common tools, equipment, machines, and materials required for one's job
14.	4.2.1-2	Interpret wages, wage deductions, benefits, and timekeeping forms
	6.2.5	Perform multiple operations using decimal fractions
15.	1.1.4-5	Select, compute, or interpret appropriate standard measurement for length, width, perimeter, area, volume, height, or weight
	6.6.5	Interpret diagrams, illustrations, and scale drawings
16.	1.1.7-5	Identify product containers and interpret weight and volume
	1.1.4	Select, compute, or interpret appropriate standard measurement for length, width, perimeter, area, volume, height, or weight
	6.6.1	Convert units of U.S. standard measurement and metric system
17.	4.7.2-3	Identify or demonstrate effective management of material resources, including acquisition, storage, and distribution
	6.1.5	Perform multiple operations using whole numbers
18.	4.5.1-3	Identify common tools, equipment, machines, and materials required for one's job
	6.4.2	Apply a percent in a context not involving money
19.	1.1.4-5	Select, compute, or interpret appropriate standard measurement for length, width, perimeter, area, volume, height, or weight
	6.6.3	Measure area and volume of geometric shapes
20.	4.4.3-5	Interpret job-related signs, charts, diagrams, forms, and procedures, and record information on forms, charts, checklists, etc.
	6.6.7	Solve measurement problems in stipulated situations
	6.6.2	Recognize, use, and measure linear dimensions, geometric shapes, or angles

ITEM	COMP.	THE LEARNER WILL DEMONSTRATE THE ABILITY TO:
21.	1.2.2-2	Compare price or quality to determine the best buys for goods and services
	4.4.3	Interpret job-related signs, charts, diagrams, forms, and procedures, and record information on forms, charts, checklists, etc.
	6.2.5	Perform multiple operations using decimal fractions
22.	1.1.1-3	Interpret recipes
	6.4.6	Compute using ratio or proportion
23.	4.4.3-2	Interpret job-related signs, charts, diagrams, forms, and procedures, and record information on forms, charts, checklists, etc.
	6.6.6	Calculate with units of time
	6.7.5	Compute averages, medians, or modes
24.	4.4.3-2	Interpret job-related signs, charts, diagrams, forms, and procedures, and record information on forms, charts, checklists, etc.
	6.6.6	Calculate with units of time
	6.4.6	Compute using ratio or proportion
25.	4.4.3-2	Interpret job-related signs, charts, diagrams, forms, and procedures, and record information on forms, charts, checklists, etc.
	6.7.5	Compute averages, medians, or modes
26.	6.6.1-3	Convert units of U.S. standard measurement and metric system
27.	4.4.3-2	Interpret job-related signs, charts, diagrams, forms, and procedures, and record information on forms, charts, checklists, etc.
	4.4.6	Interpret work specifications and quality standards
	6.3.1	Add common or mixed fractions
28.	1.3.3-3	Identify or use various methods to purchase goods and services, and make returns and exchanges
	6.2.5	Perform multiple operations using decimal fractions
29.	4.2.1-3	Interpret wages, wage deductions, benefits, and timekeeping forms
	6.4.1	Apply a percent to determine amount of discount
30.	1.5.3-2	Interpret bills
	6.4.1	Apply a percent to determine amount of discount
31.	4.2.1-2	Interpret wages, wage deductions, benefits, and timekeeping forms
	4.4.3	Interpret job-related signs, charts, diagrams, forms, and procedures, and record information on forms, charts, checklists, etc.
	6.6.6	Calculate with units of time
	6.3.5	Perform multiple operations using common or mixed fractions
32.	4.4.6-2	Interpret work specifications and quality standards
	4.4.3	Interpret job-related signs, charts, diagrams, forms, and procedures, and record information on forms, charts, checklists, etc.
	6.4.6	Compute using ratio or proportion

Table e1-14 ECS Math Form Competencies – Form 17

ITEM	COMP.	THE LEARNER WILL DEMONSTRATE THE ABILITY TO:
1.	4.4.8-3	Interpret job-related technical information, such as from service manuals and training classes
2.	4.4.8-3	"
3.	6.3.2-0	Subtract common or mixed fractions
4.	6.3.3-0	Multiply common or mixed fractions
5.	6.8.2-3	Interpret statements of probability
6.	1.1.5-3	Interpret temperatures
7.	2.3.1-3	Interpret clock time
8.	4.4.6-2	Interpret work specifications and quality standards
9.	4.4.6-2	"
10.	4.4.6-2	"
11.	4.7.2-2	Identify or demonstrate effective management of material resources, including acquisition, storage, and distribution
12.	4.7.2-2	"
13.	4.7.2-2	"
14.	4.7.3-2	Identify or demonstrate effective management of human resources, including assessing skills, making appropriate work assignments, and monitoring performance
15.	4.7.3-2	"
16.	4.7.3-2	"
17.	4.7.3-3	"
18.	6.6.1-3	Convert units of U.S. standard measurement and metric system
19.	6.6.1-3	"
20.	6.6.7-5	Solve measurement problems in stipulated situations
21.	6.6.3-5	Measure area and volume of geometric shapes
22.	6.6.3-5	"
23.	6.6.5-5	Interpret diagrams, illustrations, and scale drawings
24.	6.6.5-5	"
25.	6.5.2-5	Recognize and apply simple geometric formulas
26.	4.2.1-2	Interpret wages, wage deduction, benefits, and timekeeping forms
27.	6.6.6-3	Calculate with units of time
28.	6.6.6-3	"
29.	6.5.3-3	Recognize and apply simple algebraic formulas
30.	6.5.3-3	"
31.	6.6.3-3	Measure area and volume of geometric shapes
32.	6.6.3-3	"

Table e1-15 ECS Math Form Competencies – Form 18

ITEM	COMP.	THE LEARNER WILL DEMONSTRATE THE ABILITY TO:
1.	4.4.8-3	Interpret job-related technical information, such as from service manuals and training classes
2.	4.4.8-3	"
3.	6.3.2-0	Subtract common or mixed fractions
4.	6.3.3-0	Multiply common or mixed fractions
5.	6.8.2-3	Interpret statements of probability
6.	1.1.5-3	Interpret temperatures
7.	2.3.1-3	Interpret clock time
8.	4.4.6-2	Interpret work specifications and quality standards
9.	4.4.6-2	"
10.	4.4.6-2	"
11.	4.7.2-2	Identify or demonstrate effective management of material resources, including acquisition, storage, and distribution
12.	4.7.2-2	"
13.	4.7.2-2	"
14.	4.7.3-2	Identify or demonstrate effective management of human resources, including assessing skills, making appropriate work assignments, and monitoring performance
15.	4.7.3-2	"
16.	4.7.3-2	"
17.	4.7.3-3	"
18.	6.6.3-5	Measure area and volume of geometric shapes
19.	6.6.3-5	"
20.	6.6.5-5	Interpret diagrams, illustrations, and scale drawings
21.	6.6.5-5	"
22.	6.6.5-5	"
23.	6.5.2-5	Recognize and apply simple geometric formulas
24.	6.5.3-3	"
25.	6.6.1-3	Convert units of U.S. standard measurement and metric system
26.	6.6.1-3	"
27.	4.2.1-2	Interpret wages, wage deduction, benefits, and timekeeping forms
28.	6.6.3-3	Measure area and volume of geometric shapes
29.	6.6.3-3	"
30.	6.6.6-3	Calculate with units of time
31.	6.6.6-3	"
32.	6.5.3-3	Recognize and apply simple algebraic formulas

Item **e2 – Whether the items or tasks measure skills that are not associated with the NRS educational functioning levels**

All items in the *ECS Math Assessments* measure skills that are associated with the NRS educational functioning levels. The *ECS Math Assessments* do not measure competencies or skills that are not tied to the NRS educational functioning levels for ABE and ESL adults.

Item e3 – Whether aspects of a particular NRS educational functioning level are not covered by any of the items or tasks

The items that comprise the assessments in the *ECS Math Assessments* measure skills that span the continuum within and across each of the NRS educational functioning levels.

Item e4 – The procedures used to establish the content validity of the test

Math as measured in the *ECS Math Assessments* is in functional contexts commonly encountered in employment related settings. The competencies – or the content – selected to measure Math was determined by conducting a statewide survey of California business and industry, workforce developers and trainers, and adult educators preparing learners for employment. They identified and prioritized a subset of the CASAS Competencies as being critical and important for jobs that do not require postsecondary degrees. This set of priority competencies provided the content framework for the ECS Math pre- and post-tests. The competencies included on the ten ECS Math test forms are listed in Tables e1-4 through e1-7, e1-14, and e1-15.

The competencies – or the content – selected to measure math in the WLS series was determined by results collected over a 12-year period from the Workforce Learning System (WLS) Basic Skills Analysis process used in hundreds of businesses in many states. CASAS summarized the WLS competencies – a subset of the CASAS Competencies – identified by a broad section of industries as being critical and important basic skills for jobs that do not require postsecondary degrees. These results confirmed what other national initiatives also identified as critical work-related basic skills needed for success in today's job market. This set of priority competencies provided the content framework for the WLS math pre- and post-tests. The competencies included on the WLS math test forms appear in Tables e1-8, e1-9, e1-12, and e1-13.

Content validity of the *ECS Math Assessments* were established through panels of educational specialists who provided assurance that the test items developed for each specific set of tests accurately assessed Math skills in the context of the identified competencies.

A math item assessing competency 1.2.2 *Compare price, quality, and product information to determine the best buys for goods and services* might involve interpreting prices on a sale sign or ad in a store or on a flyer or in a newspaper, or looking at a price list on a Web page. In addition to the specific math skill involved in answering the question – for example:

6.1.2 *Subtract whole numbers*
6.1.5 *Perform multiple operations using whole numbers*
6.2.4 *Divide decimal fractions*
6.4.1 *Apply a percent*

the item might also address, depending on its particular content:

1.2.1 *Interpret advertisements, labels, charts, and price tags in selecting goods and services*
1.2.3 *Compute discounts*
1.2.4 *Interpret or compute unit pricing*
1.3.1 *Identify, compare and use methods for purchasing goods and services, including online purchasing*

Test items also are presented in a variety of task types:

- Forms
- Charts, maps, consumer billings, matrices, graphs or tables
- Articles, paragraphs, sentences, directions, manuals
- Signs, price tags, advertisements or product labels
- Measurement scales or diagrams

Content Validity Confirmatory Study

A panel of five Subject Matter Experts (SMEs) was convened to review all items in the ECS and WLS Math series. All panelists had training and extensive experience in the field of adult ABE and ASE (see Table e4-1).

Table e4-1 ECS and WLS Math Alignment Study SMEs

Name	Title	Agency	State	Degrees	Years Experience ABE and ASE
Panelist #1	Consultant	Ohio Department of Education Adult Basic and Literacy Education	OH	BS Ed MA Adult Ed	ABE – 15 ASE - 15
Panelist #2	Consultant	Ohio Literacy Network	OH	MA Ed	ABE – 10 ASE - 20
Panelist #3	Assistant Principal	New Haven Adult School	CT	MA	ABE – 20 ASE - 20
Panelist #4	Instructor and Trainer	CREC, ATDN	CT	BS Ed MS Ed	ABE – 27 ASE - 27
Panelist #5	Assistant Principal	Escondido Adult School	CA	MA MFA	ABE – 2 ASE – 1

Panelists were provided with test booklets and Test Administration Directions for Math Forms 11 – 18 and 213 – 216. They were also provided with math descriptors from the "Numeracy" and "Functional and Workplace Skills" columns of the NRS Educational Functioning Level ABE Descriptors (see Appendix A). The NRS Educational Functioning Level ABE Descriptors describe a continuum of difficulty in numeracy skills from beginning to advanced levels of ability.

The process involved two sets of judgments: (1) judgments of the content match between CASAS math test items and NRS ABE Educational Functioning Level Descriptors, and (2) judgments of the content match between CASAS math test items and CASAS math content standards categories.

Panelists were convened via conference call to receive an overview of the purpose and design of the study, to review and discuss the NRS ABE Educational Functioning Level Descriptors for Numeracy and Functional and Workplace Skills in detail, and to convey alignment rating instructions for judging CASAS test items. For each test form, they were given a separate rating sheet to record their responses. Panelists were given the following specific instructions in writing and on the phone:

- For each CASAS math test item, read the item and review any related pictures, the correct response, and distractors in the test booklet.
- Use the ***NRS Numeracy Descriptors for ABE*** chart (pages 2 – 3) to make an independent judgment about which NRS ABE Level (1 – 6) the item **most fits with**. Focus on the math skills being **targeted** in this item.

- Enter the NRS ABE Level number from 1 – 6 in the chart next to the item number.
- Mark an "X" in any of the *CASAS Math Content Standards* category columns on the right that relate to the primary math skills being **targeted** in the item.
- If the item doesn't fit with any NRS level, mark "N/A."

Reviewers were asked to select only one NRS level for each item to target the primary inference that could be drawn from correctly answering the item. They were permitted to select more than one content standard category for each item. They were told that "item fit" was defined as relating 50.1 percent or more to one NRS level in relation to an adjacent NRS level.

They were also asked to mark "N/A" if they judged an item to **not** fit with any NRS level, or if they judged an item **not** to be measuring numeracy.

Panelists were asked to enter their ratings directly into the Excel file. There was one Excel file with a separate "worksheet" tab for each test form. Panelists were asked to proceed test level by test level, beginning with the Level A (easiest ability level) test forms. Panelists were asked to rate all items at all levels in Round 1, and submit their ratings. Round 1 ratings were compiled and analyzed for judgment agreement.

Panelists were asked to make independent judgments for each item in Round 1. They were told that the results from their initial Round 1 agreements would be reported in our study findings to estimate the level of independent agreement among panelists. They were also informed in advance that there would be a Round 2 meeting to review, discuss and arrive at a consensus on items that they had not agreed on in Round 1.

This design was informed by a study on the impact of consensus on alignment judgments (Chin, Rodeck, Buckendahl, & Foley, 2008) which evaluated the impact of group discussion on reviewers' judgment agreement. In this study, alignment inferences based on individual ratings were compared with alignment inferences based on consensus ratings. Results suggested that judgment consistency may improve with an in-depth discussion and consensus process, but that alignment inferences generated with individual ratings or consensus ratings had little effect on the final alignment conclusions.

In Round 2, panelists were convened in two 2.5-hour sessions via conference call to engage in consensus discussions and make final group-level judgments on items that were not in agreement at a decision rule of 60 percent or greater exact-level agreement in Round 1. They were also permitted to modify exact judgment agreements from their independent ratings in Round 1, based on the group discussion and consensus process.

Panelists were sent evaluation forms that included questions regarding their confidence in their alignment judgments and their perceptions of the process in order to provide evidence of procedural validity as suggested by Davis and Buckendahl (2008). The evaluation form may be found in Appendix C. One response has been received to date indicating an overall positive experience with the study.

Analysis

Our decision rule for Round 1 independent judgments required exact agreement of 60 percent or greater. For judgments that were not in agreement regarding the NRS level, we used the median rating to establish a decision point from Round 1.

Panelists were encouraged to discuss items during the consensus activity, but were also told that they did not need to unanimously agree to make a consensus decision for an item. For Round 2, the decision rule for consensus judgments was exact agreement of 60 percent or greater. All items that were not in exact agreement in Round 1 were resolved through consensus discussion in Round 2.

Results

Round 1

Overall, for the first round of ECS and WLS Mathematics alignment by NRS level, exact agreement was observed 87.56 percent of the time across forms and exact/adjacent agreement was observed 100 percent of the time. For the first round Mathematics alignment by content area, exact agreement was observed 98.39 percent of the time across forms and exact/adjacent agreement was observed 100 percent of the time.

Round 2

Overall, for the second round of the Mathematics alignment, exact agreement by NRS level was observed 87.56 percent of the time across forms and exact/adjacent agreement was observed 100 percent of the time. For the second round Mathematics alignment by content area, exact agreement was observed 98.39 percent of the time across forms and exact/adjacent agreement was observed 100 percent of the time.

The results show a high level of alignment of each test form to the NRS levels and the defined content levels.

Item e5 – The number of subject matter experts who provided judgments linking the items or tasks to the NRS educational functioning levels and their qualifications for doing so, particularly their familiarity with adult education and the NRS educational functioning levels

At the request of the CASAS National Consortium, representing approximately 30 states, CASAS developed math basic skills content standards as a formal part of the CASAS system. This National Consortium project was coordinated with the assistance of a thirteen-state technical workgroup comprised of math subject matter experts. The initial process included a review of existing state adult education content standards for California, New York, Massachusetts, Arizona, Maryland, and Florida, as well as a review of a variety of other national and state standards documents. The National Consortium Technical Workgroup used this information as a basis to begin development and pilot testing of the CASAS Basic Skills Content Standards. These standards were

then correlated to CASAS performance levels, the WIA II National Reporting System levels, and aligned to CASAS assessments. Several states extensively field-tested the content standards to ensure they were complete and that they were aligned with CASAS and NRS levels. These basic skills content standards assist adult education instructors identify the underlying basic skills embedded in employment related life skill competencies to strengthen teaching and learning.

(f) Match of scores to the NRS educational functioning levels. Documentation of the adequacy of the procedure used to translate the performance of an examinee on a particular test to an estimate of the examinee's standing with respect to the NRS educational functioning levels

Item f1 – The standard-setting procedures used to establish cut scores for transforming raw or scale scores on test into estimates of an examinee's NRS educational functioning level

The initial goal of CASAS since the 1980s was to develop a adult competency measurement scale that would assist adult educators in describing the functional performance capabilities and levels of their learners. The adult competency measurement scale to be developed needed to be sensitive to the learning accomplishment of learners enrolled in the various levels of ABE, ASE, and ESL classes. Learners used in the development of the initial scale were enrolled in classes that were supported in part by federal adult education act funding — currently WIA Title II. It was decided by a group of California adult education practitioners, and later verified by national leaders and state directors of adult education, that item content and presentation formats should reflect the content and competencies underlying both the Adult Performance Level Study (1974) and the California High School Proficiency Examination (1975) that measured the attainment of basic skills in a functional life skills context. These item types later were expanded to include employment-related contexts and measured, in addition to reading and math, listening and writing.

The strategy was to create items and to field-test them on adult education learners who could successfully handle common, noncomplex reading and math in a life skills context. Learners enrolled at the intermediate levels of adult education were chosen as examinees for the initial field-testing and linking of items to a common adult competencies measurement scale. The Rasch IRT scaling procedure was chosen to facilitate the concurrent calibration and the vertical equating of the field-tested items. Using these scaling procedures, easier and more difficult items were added to extend the adult competencies measurement scale both lower and higher. A reporting scale was developed that was distinct from other K-12 and college entrance educational scales by centering the CASAS scale with a mean of 200 with a standard deviation of 10 scale points.

The content and competencies were analyzed for the items forming the typical CASAS scale score ranges of adult (theta) ability values from below 170 to 240 and above and were found to compare favorably with the findings from other national studies, including

the Student Performance Level Study conducted by the Center for Applied Linguistics (CAL, 1984). These scale ranges were then used to describe and level instruction while providing a reporting mechanism for programs and states adopting CASAS throughout the nation for their adult education and literacy learners.

In the mid-1990s, with the development and establishment of the National Reporting System (NRS), these CASAS scale score ranges were reviewed and modified to fit the current NRS educational functioning levels used to report the performance of learners enrolled in adult education and literacy programs supported in part by federal funding under WIA Title II. These new scale ranges were presented to the United States Department of Education – Adult Education by Patricia Rickard to Ronald Pugsley (personal communication, April 5, 1996).

On each parallel test form pairing in the *ECS Math Assessment Series*, the accurate range of scale scores covering more than one NRS educational functioning level is identified. The conditional standard error (CSEM) for all NRS cut scores is less than 5.6.

Standard Setting Cut Score Study

In February and March 2008, CASAS conducted formal performance standard setting studies as part of its process to periodically review and continuously validate all CASAS assessments. The goal was to use a test-centered judgment based standard setting procedure to re-examine and provide evidence of the relationship between CASAS scale scores and the NRS Educational Functioning Levels.

While performance level cut scores are the result of a subjective judgment process by subject matter experts (SMEs) and are impossible to prove as correct (ETS, 2004), performance level cut score validation studies provide useful information if conducted using a carefully followed procedural design with expert SMEs.

Separate performance level standard setting studies were conducted for each skill area or "modality" – reading, math, and listening. The results of the standard setting process for the math modality are included in Table f1-1. The cut scores and scale were reviewed for consistency with the reporting and analytical guidelines and standards established in the ETS Standards for Quality and Fairness (ETS, 2002).

A group of demographically diverse SMEs in adult education within each specific skill area were convened to identify the performance level descriptors and cut scores which separate each of the NRS Educational Functioning Levels. From the panelists who were invited to participate for each skill area, two similar but independent panels were formed, with different panel leaders/facilitators, so that the results from each panel could be compared for consistency.

Panels consisted of four to six adult education experts with two separate panels for each modality (reading, math, and listening). Selection of panelists was based on their individual relevant adult education expertise and their ability to devote uninterrupted time to the study. Each panel was conducted remotely over a consecutive two-day period.

Panelists included experienced teachers, professional development specialists and adult education administrators from a variety of backgrounds, including the local agency level and state education departments. On the math panel participants' adult education experience ranged from 14 – 37 years, leading to a qualified group of SMEs. There were nine states represented in the two reading panels, seven states in the listening panels, and six states in the math panels, encompassing 15 states in all four continental US time zones (CA, CO, CT, DC, FL, IA, KS, MD, MI, MN, NC, OH, OR, RI, VA). A list of the panelists and their relevant experience is included in Table f2i-1 and f2i-2. A survey of panelists conducted at the end of the study found that they were generally satisfied with the way that the study was conducted, including clear explanations, facilitation procedures and materials, and adequate time to process and discuss their responses.

The Bookmark standard setting method, a common technique for setting multiple performance standard setting cut points for tests that use Item Response Theory (IRT), was chosen to allow for SMEs to identify the cut scores that they deemed appropriate for each of the NRS Functioning Levels. This method was possible and appropriate for the CASAS assessments due to the availability of extensive IRT data on each test question.

The bookmark standard setting method is displayed visually in Figures f1-1, f1-2, and f1-3 (Maryland State Department of Education, 2004).

Figure f1-1 The Bookmark Standard Setting Procedure

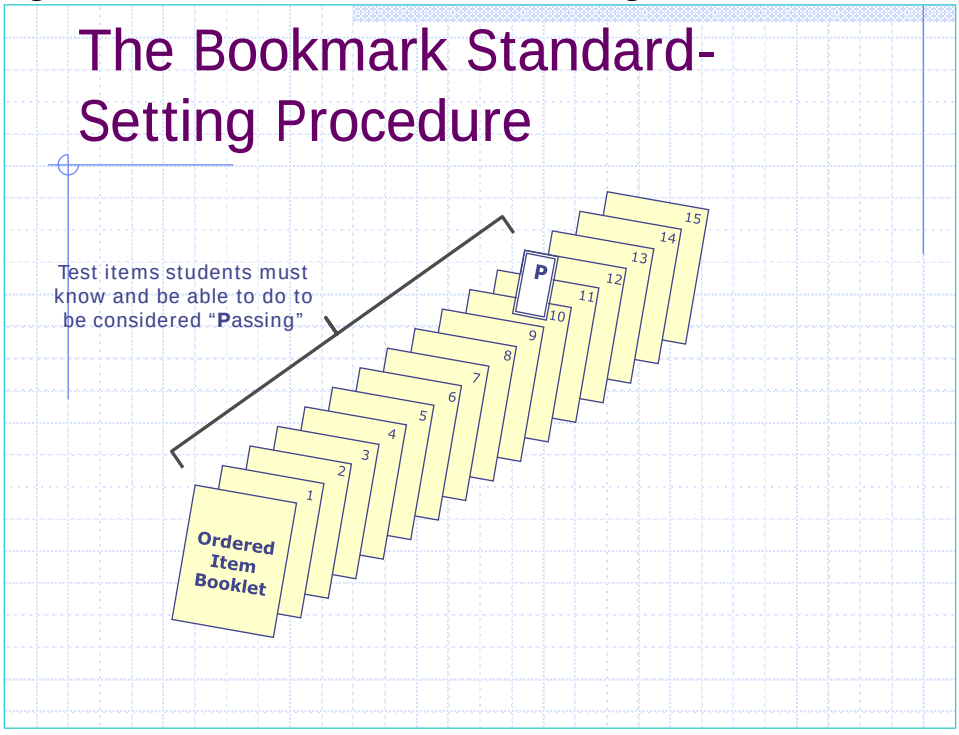


Figure f1-2 The Bookmark Standard Setting Procedure (cont.)

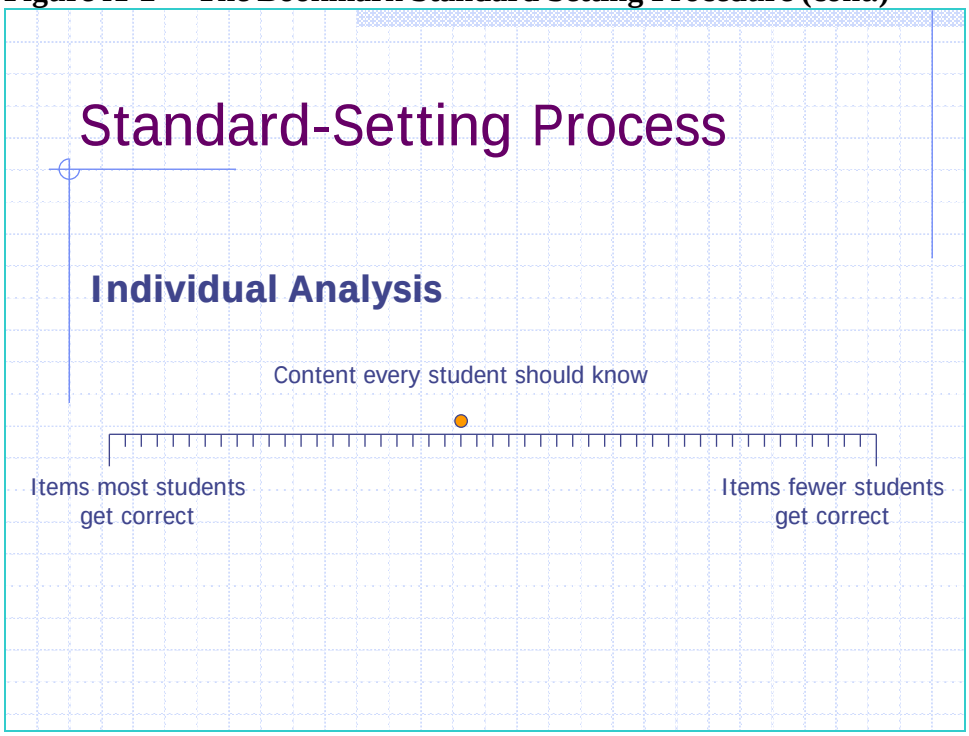
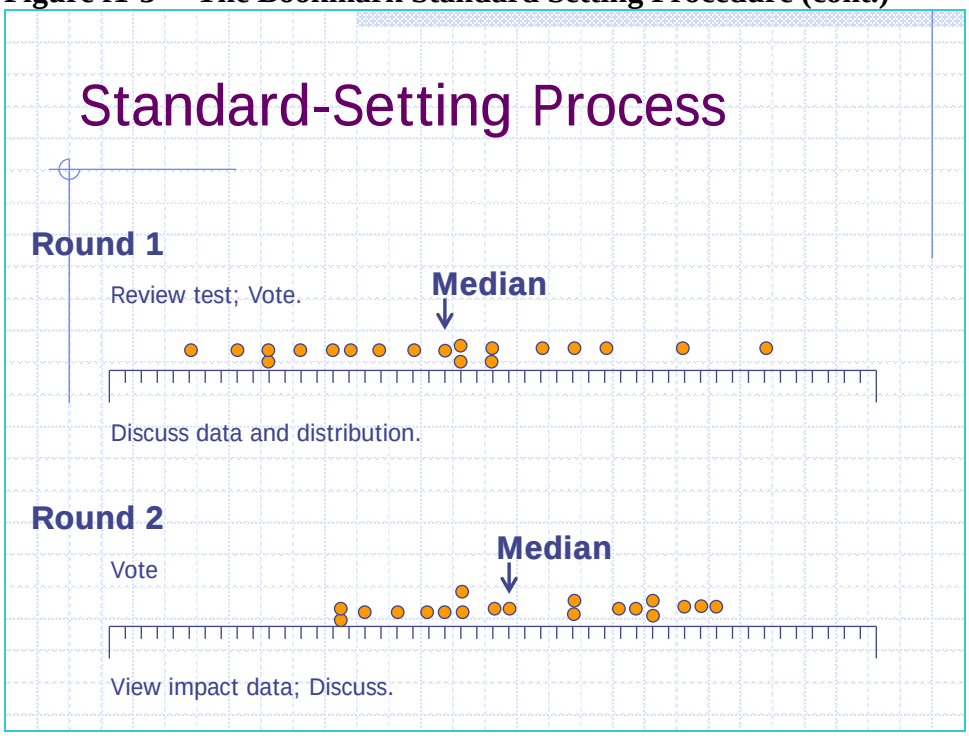


Figure f1-3 The Bookmark Standard Setting Procedure (cont.)



The implementation of the Bookmark method follows the general guidelines outlined in *A Primer on Setting Cut Scores on Tests of Educational Achievement* (ETS, 2004). Judgment experts were provided Ordered Item Booklets (OIBs) which included actual multiple-choice test items in order of difficulty from easiest to most difficult. All items in

the odd-numbered parallel test forms were included from the ECS math series in order to adequately represent the entire content, task areas, and difficulty range of the tests in the ECS math series. Items from other ECS math test forms were also included to expand the number of items at the existing CASAS defined NRS cut scores. There were a total of 331 items in the Math OIB.

The SMEs were provided information on the content standards, performance level descriptors, a bookmark recording form and the ordered item booklets described above including item type, item directions, and the correct answer for each question, in addition to the display/prompt, stem and distractors.

The panel leader began each panel with an explanation of the purpose of the study and the bookmark standard setting procedure and process. The panel leader also led the panelists through a detailed examination of the NRS Educational Functioning Level descriptors for each level, focusing on the descriptors that were relevant for each panel's work. The math panel reviewed the descriptor language related to math from the "Numeracy Skills" and the "Functional and Workplace Skills" columns for ABE.

Three rounds of bookmark placements were conducted for each modality (reading, math and listening). For each judgment round, the SMEs, working individually and independently, were asked to place a bookmark between the most difficult question that borderline or minimally competent examinees would be likely to answer correctly at least 50 percent of the time, and the easiest question that they would not be likely to answer correctly at least 50 percent of the time at the border or transition between NRS Educational Functioning Levels. Thus, the Bookmark response probability or RP value for these studies was RP50. The panel members then reconvened to discuss their individual bookmark placements for each round. Feedback was provided to the SME panelists regarding the high, low and median bookmark placements.

Between the second and third rounds, the panelists were provided with impact data from three states contained in two summary tables. The first table contained the percentage of students placed in each NRS level using the current CASAS cut points for California, Oregon and Iowa, as well as aggregate data for the three states. The second table contained the percentage of students placed in each NRS level using the standard setting panel group median Round 2 bookmark recommendations if they were implemented. The panelists were then able to compare results from the two sets of performance levels (percent of examinees from existing NRS levels from three states and the percent of examinees at the NRS levels using the standard setting panel performance levels). By examining the changes in percentages of students that would be placed in each NRS level using the standard setting panel recommendations, they could see the effects or impacts of their individual and group panel median bookmark recommendations. The panelists could see if they did in fact believe, for example, that 20 percent of students should be enrolled in Low Adult Secondary Education, as compared to 10 percent using the current NRS performance levels for the three states.

The impact data provided another perspective for panelists to consider in making adjustments to their bookmarks if they perceived important differences between their

knowledge and understanding of this student population and the effects of their existing Round 2 bookmark placements. During this process, the panelists were not provided with the related CASAS scale scores. Panelists discussed the ramifications of the impact data, and then had an opportunity to revise or maintain their bookmarks for the last judgment round.

Once the panels concluded their work, the results were examined comparing the current NRS cut points and the recommendations from the two independent standard setting panels for each of the three modalities (reading, math and listening).

Results of the existing NRS cut score levels and the results from the two independent panels of SME judges for ABE Math are summarized below in Table f1-1. Note the high degree of consistency between the three performance level cut scores from the existing CASAS NRS cut scores and the recommended performance level cut scores recommended by the independent panels from the standard setting study. Evidence regarding the agreement between the judgments of the independent panels of SMEs is presented in Item f2ii and Tables f2ii-1 and f2ii-2.

Standard setting is a judgment based process which provides valuable advisory information to be reviewed and considered by the standard setting policy body. In the final stage of the standard setting process, CASAS reviewed the panels' recommendations in the light of other research and policy considerations. For all NRS instructional levels except for advanced levels, the results of the performance standard setting study confirmed the validity of the current CASAS NRS cut scores for the Educational Functioning Levels. At the advanced level, additional score validity studies are recommended. Current studies cited in this technical manual, including the CASAS/GED Study, the CASAS WorkKeys Study, and the CASAS/CAHSEE Study all indicate that the current cut scores at the advanced levels are appropriate.

Table f1-1 Standard Setting Cut Score Study Results – ABE Math

NRS ABE Educational Functioning Levels	CASAS Cut Score	Panel 1 Cut Score	Panel 2 Cut Score
Beg. ABE Literacy	200 and below	195 and below	196 and below
Beg. Basic Ed.	201	196	197
Low Int. Basic	211	209	209
High Int. Basic	221	218	218
Low Adult Secondary	236	233	231
High Adult Sec	246	238	241

Item f2 – Information on judgment based procedures

(f2i) The number of subject-matter experts who provided judgments, and their qualifications

Table f2i-1 Standard Setting Cut Score Study – Panelist Information

Modality	Number of Panelists	States Represented	Experience in Adult Education (Range in Years)
Math Panel 1	5	CA (2), CT (2), MN	14 - 34
Math Panel 2	6	CA, CT, KS, MD, OH (2)	20 - 37

Table f2i-2 Standard Setting Cut Score Study – Detailed Panelist Information

Modality	Dates	Participants-Title
Math Panel 1	March 6 – 7, 2008	**Panelist #1a**, CT- ABE Instructor, Hartford Adult Ed. **Panelist #1b**, CT-Professional Development Specialist and Trainer, CREC/ATDN **Panelist #1c**, CA- Resource TSA, Sweetwater Union High School District **Panelist #1d**, CA (also leader)- Program Specialist, CASAS **Panelist #1e**, MN- Retired ABE instructor
Math Panel 2	March 12 – 13, 2008	**Panelist #2a**, OH- Consultant, Ohio Board of Ed. **Panelist #2b**, MD-Instructor, GED, ABE, EDP, Virtual Enterprise Program, Catholic Charities **Panelist #2c**, CA- CASAS Consultant, CA Certificated High School Math Instructor **Panelist #2d**, KS-State Director of Adult Education, Kansas Board of Regents **Panelist #2e**, CT-Professional Development Trainer, CREC/ATDN **Panelist #2f**, OH-Executive Director, Ohio Literacy Network

(f2ii) – Evidence of the extent to which the judgments of subject matter experts agree

Tables f2ii-1 expands on the results presented in Tables f1-1. These tables provide evidence of the extent to which the judgments of the SMEs were in agreement. To guide in the interpretation of the table, the column headings can be defined as follows:

Panel One Difference/Panel Two Difference – reports the difference between the cut score arrived at by each panel compared to the current CASAS Cut Score. Positive values indicate that the standard setting panel cut score means were above the current CASAS NRS Level Cut Score. Negative values indicate that the standard setting panel cut score means were below the current CASAS NRS Level Cut Score.

Panel One Standard Dev/ and Panel Two Standard Dev – reports the standard Deviation of the individual panel members cut scores

Mean Difference – reports the mean difference of the cut scores arrived at by the two panels compared to the current CASAS cut score

Table f2ii-1 Standard Setting Cut Score Study SMEs Agreement – ABE

NRS ABE Educational Functioning Levels	CASAS Cut Score	Panel 1 Difference	Panel 1 Standard Error	Panel 2 Difference	Panel 2 Standard Error	Mean Difference
Beg. ABE Literacy	200 and below					
Beg. Basic Ed.	201	-5	0.00	-4	0.67	-4.5
Low Int. Basic	211	-2	0.20	-2	0.17	-2
High Int. Basic	221	-3	0.00	-2	0.22	-2.5
Low Adult Secondary	236	-3	0.00	-5	0.00	-4
High Adult Sec	246	-8	0.00	-5	0.00	-6.5

Item f3 – The standard error of each cut score, and how it was established; and

Table f3-1 shows the relationship of CASAS levels to NRS educational functioning levels (EFL) for ABE and ASE. For example, an ABE student who scores 208 on an ECS Math test is classified into CASAS level B and NRS Beginning Basic Education.

Table f3-1 Relationship of CASAS levels to NRS for ABE and ASE

NRS Educational Functioning Levels		CASAS Level	Math Scale Score Ranges
1	Beginning ABE Literacy	A	200 and below
2	Beginning Basic Education	B	201-210
3	Low Intermediate Basic Education	B	211-220
4	High Intermediate Basic Education	C	221-235
5	Low Adult Secondary Education	D	236-245
6	High Adult Secondary Education	E	246 and above

Table f3-2 provides the conditional standard error (CSEM) for each ECS math scale score that is a cut point for an ABE and ASE NRS educational functioning level by form. For example, if an examinee is administered Form 13 and achieves a scale score of 200, the cut score associated between CASAS levels A and B and NRS educational functioning levels Beginning ABE Literacy and Beginning Basic Education, the CSEM is 3.7. This means that at the 68 percent confidence level the true scale score at a scale score of 200 falls within the range of 196.3 and 203.7. The recommended scale score range for each form is highlighted. This range corresponds to scores with a CSEM less than 5.6.

Table f3-2 ECS Math Forms — CASAS NRS Functional Instructional Cut Score Points and CSEM for ABE and ASE

NRS Scale Score Cut Points		Level A				Level B							
		Form 11		Form 12		Form 13		Form 14		Form 213		Form 214	
		Scale Score	Std Error	Scale Score	Std Error	Scale Score	Std Error	Scale Score	Std Error	Scale Score	Std Error	Scale Score	Std Error
	180	180	4.7	180	4.7								
Beginning ABE Literacy	190	190	4.3	190	4.3	191	4.7	191	4.4	191	4.8	191	4.9
	200	200	4.7	200	4.7	200	3.9	200	3.9	201	4.1	201	4.1
Beginning Basic Education	210					210	3.8	210	3.8	210	4.0	210	4.0
Low Intermediate Basic Education	220					220	4.4	220	4.4	219	4.4	219	4.4
High Intermediate Basic	235												
Low Adult Secondary Education	245												
High Adult Secondary Education	246+												

Table f3-2 ECS Math Forms — CASAS NRS Functional Instructional Cut Score Points and CSEM for ABE and ASE (cont.)

NRS Scale Score Cut Points		Level C								Level D			
		Form 15		Form 16		Form 215		Form 216		Form 17		Form 18	
		Scale Score	Std Error	Scale Score	Std Error	Scale Score	Std Error	Scale Score	Std Error	Scale Score	Std Error	Scale Score	Std Error
Beginning ABE Literacy	180												
	190												
	200	200	5.5	200	5.5	200	5.4	200	5.4				
Beginning Basic Education	210	209	4.3	209	4.2	209	4.2	209	4.2				
Low Intermediate Basic Education	220	220	3.8	220	3.8	220	3.7	220	3.7	220	4.6	221	4.6
High Intermediate Basic Education	235	234	4.5	234	4.6	235	4.5	235	4.4	235	3.9	234	3.8
Low Adult Secondary Education	245									244	4.1	244	4.1
High Adult Secondary Education	246+												

Item f4 – The extent to which the cut scores might be expected to differ if they had been established by a different (though similar) panel of experts

Results from the performance standard setting score study show that two independent panels of experts identified comparable cut score values for identifying placement into the majority of NRS Educational Functioning Levels. As expected, some NRS Educational Functioning Levels did show measurable differences between the two independent panels and the CASAS cut score points notably: High Adult Secondary and Beginning ABE Literacy. The use of two independent panels provides a direct comparison of the difference in cut scores to be expected by the use of different panels of experts. Expected cut score differences are computed within and across panels and Educational Functioning Levels. Evidence shown here would recommend additional score validity investigations regarding the cut score for High Adult Secondary and Beginning ABE Literacy. As described herein, CASAS already has such validity investigations underway. Current studies cited in this technical manual, including the CASAS/GED Study, the CASAS WorkKeys Study, and the CASAS/CAHSEE Study all indicate that the current cut scores at the advanced levels are appropriate. Please refer to Tables f1-1 and f2ii-1 for information on the cut scores arrived at by the two independent panels of experts. Please also refer to Item H of this technical manual for additional studies related to the ECS Math Assessments cut scores.

(g) Reliability. Documentation of the degree of consistency in performance across different forms of the test in the absence of any external interventions

Item g1 – The correlation between raw (or scale) scores across alternate forms of the test or, in the case of computerized adaptive tests, across alternate administrations of the test

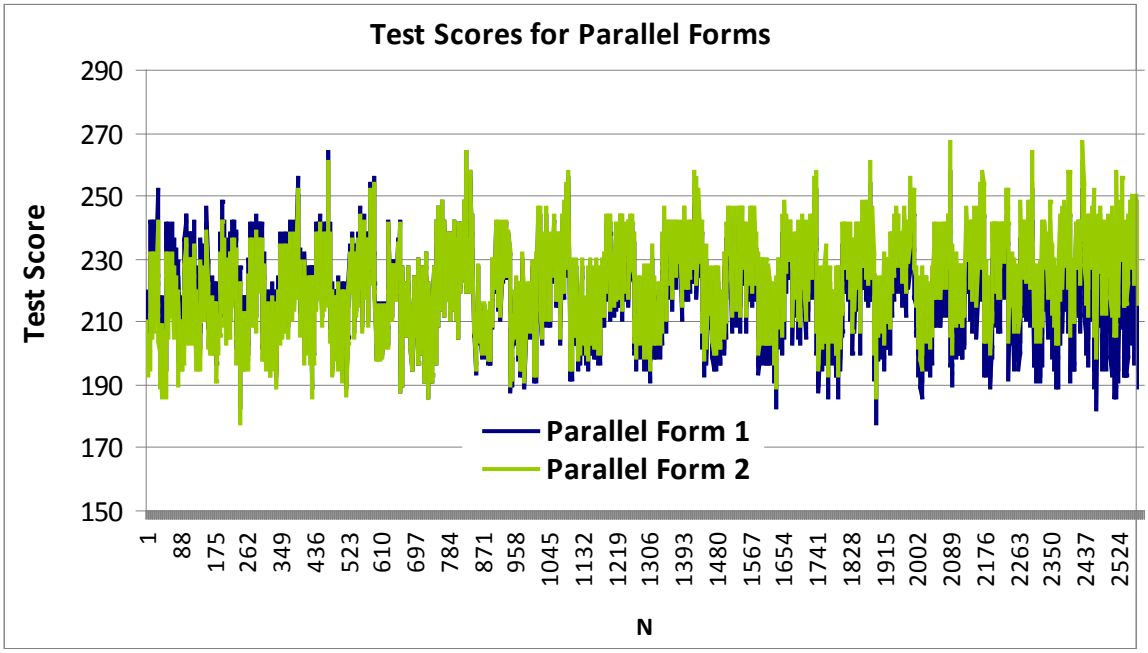
The parallel forms that comprise the *ECS Math Assessments* are constructed so that the two forms can be used independently of each other and are considered equivalent measures. The items within the parallel forms contain comparable content to reflect the same construct. Examinees with similar ability taking the parallel forms of the tests should show comparable performance. The correlations listed in Table g1-1 are estimates of parallel reliability of scores between the two alternative forms taken by the same examinees. The data below shows the correlations of scores across alternate forms of the test in the ECS Math Test Series. Examinees who tested with the parallel forms at an interval of **15 days** and scoring within the accurate range of each test form are included in the analysis. The overall test score correlation of the 2,591 examinees who tested with the parallel forms are .86 i.e.74 percent of the variation in performance on one parallel form of the test can be accounted for by scores on the other parallel form of the test. Nearly 84 percent of the 2,591 examinees had a test score correlation of .93 excluding the 16 percent outliers.

Table g1-1 Correlations between Parallel Forms

Math Level				Parallel Forms
A	Correlation	0.75	0.82	11M-12M
N=85	% of N	100.0	91.8	
B	Correlation	0.71	0.85	13M-14M
N=1,070	% of N	100.0	84.3	
C	Correlation	0.70	0.82	15M-16M
N=1,143	% of N	100.0	89.2	
D	Correlation	0.82	0.89	17M-18M
N=293	% of N	100.0	85.3	
All Examinee	Correlation	0.86	0.93	All parallel forms
N=2,591	% of N	100.0	83.9	

Figure g1-1 graphically presents examinees' score on the parallel form1 in comparison to the form 2.

Figure g1-1 Graphical Representation of Scores on Parallel Forms



Item g2 – The adequacy of the research design leading to the estimates of the reliability of the test

The empirical analyses listed in Item g1 involved the collaboration of psychometric and data collection experts in the field of adult education. A detailed summary of the results of each study is included in Item g1.

The research designs for the parallel forms correlation and classification consistency studies each focused on the proper selection of the study population to ensure representation of the adult education population being served. Item g2i details the size of the population associated with the research designs, and g2ii presents the demographic characteristics of the population studied.

In the analyses presented in Item g1, CASAS used examinee data submitted by agencies that provide adult education services under WIA Title I and WIA Title II. CASAS is responsible for the collection and aggregation of these submissions via the TOPSpro™ (Tracking of Programs and Learners) software. The data collection process follows strict guidelines to ensure accuracy and uniformity. This begins with the training process for test administrators and scorers (See Item i4) and continues as the data – received by CASAS on a quarterly basis – is then subject to rigorous data quality checks.

The research designs for each study take into consideration and can be described by five "elements" of research design: observations or measures, treatment or programs, groups, assignment to group, and time (Trochim, 2006). The layout design for the empirical data analyses generally follows the example outlined in Table g2-1 and Figure g2-1.

Table g2-1 Research Design Summary for Parallel Forms Correlation Analysis

Observations/Measures:

The first measure is the test score for examinees who took a test during a given program year(s). The second measure is the score on the parallel test form given to examinees within five days of the date that they took the first test.

Treatment or Programs:

There is the possibility of instruction between the two tests; however, the study is designed to limit this as much as possible by allowing a maximum of only five days between the two tests.

Groups:

The data is grouped into four subgroups: examinees taking CASAS level A, B, C, and D test forms.

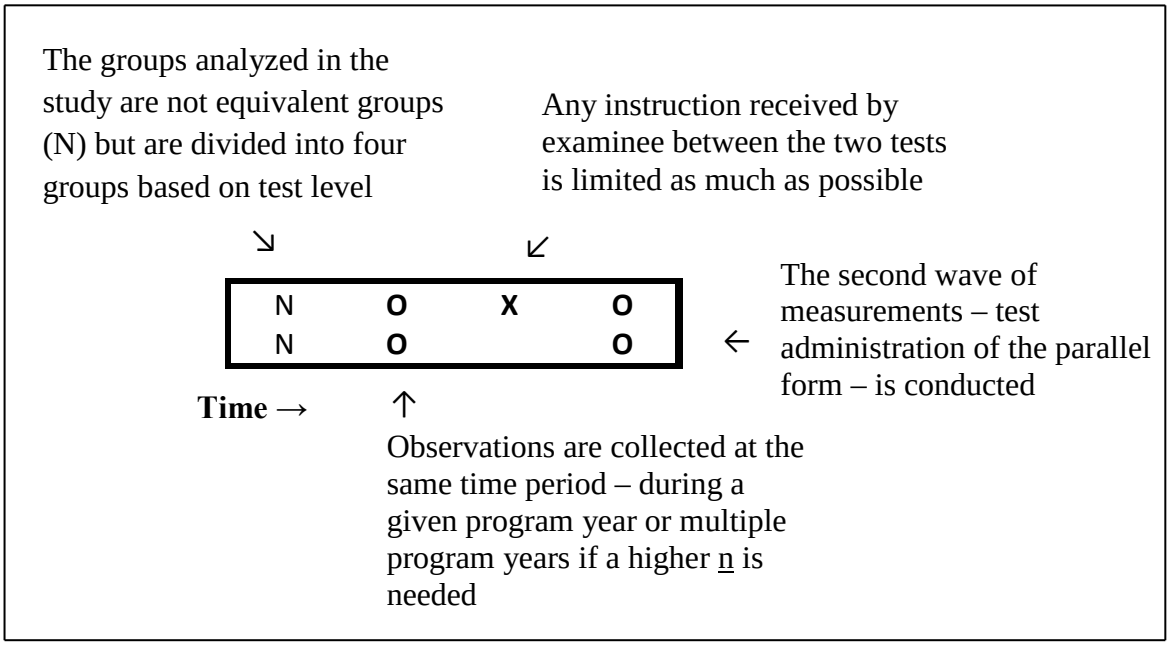
Assignment of Groups:

The four groups are not equivalent (N) and are assigned to an educational level based on test score.

Time:

Time moves from left to right in Figure g2-1 showing that once the groups are identified, the learning gains (difference between test one and test two) are then calculated and analyzed.

Figure g2-1 Research Design Notation for Parallel Forms Correlation Analysis



Item and test form data is further reviewed by psychometric experts to determine if items and test forms conform to psychometric standards such as unidiminsionality, inter-item

consistency (KR 20), model fit, differential item functioning, standard errors of measurement, and other standards. When items do not appear to meet standards, they are reviewed again by psychometric and subject matter experts for possible elimination, revision, or retention of the items. After items are calibrated, reviewed, and included on test forms, a raw to scale score is calculated and linked back to original scale. Only scale scores with a conditional standard error of measurement (CSEM) less than 5.6 are included in the accurate range of the test (see Item d2).

In addition, when conducting analyses such as those included in Item g1, psychometric experts review all data to determine if further controls are necessary based on the specific data analysis. For the purpose of these analyses, any exams with scores that did not fall in the accurate range with a CSEM less than 5.6 (see Item d2) were eliminated. The access to this robust dataset from a complete population of examinees, collected based on the strict standards and procedures that CASAS follows, allows for a high level of confidence in the results.

CASAS continually conducts research related to reliability of *ECS Math Assessments* . CASAS regularly updates analyses, such as the Parallel Form Reliability and Classification Consistency, as part of its continuous reliability measures to ensure that the assessments remain reliable over time. The analyses presented in Item g-1 are from 2005-06 program year data.

(g2i) The size of the samples

Table g2i-1 includes the sample sizes for the Parallel Forms analysis.

Table g2i-1 Sample Sizes for Reliability Analyses

Study	N
Parallel Forms (Table g1-1)	2,591

(g2ii) The similarity between the sample(s) used in the data collection and the adult education population

Table g2ii-1 includes the demographics characteristics for the Parallel Forms analysis.

Table g2ii-1 Demographic Characteristics for Reliability Analyses

	Examinees	Gender		Ethnicity				Years of Education		Language	
Study	N	Male	Female	White	Hispanic	Asian	Black	6 and below	7 and higher	English	Non English
Parallel Forms	2,591	1,719	852	717	1,032	60	675	95	2,304	1,937	654

(g2iii) The steps taken to ensure the motivation of the examinees

The correlation between parallel forms and classification consistency by NRS functioning level use actual aggregated student pre- and post-test data test data administered during the course of regular classroom instruction and assessment. Examinees who did not score in the accurate score ranges on both parallel forms were not included in the analysis.

Item g3 – Any other information explaining the methodology and procedures used to measure the reliability of the test

Table g3-1 shows the mean score, standard deviation, and the KR-20 reliability for the ECS series. The alternate forms have similar mean scores and standard deviations. As a measure of internal consistency reliability, the KR-20 is the average inter-item correlation among items in the form.

Table g3-1 Reliability Summary Statistics

ECS Math Forms	No. of Items	N	Mean Scale Score	Standard Deviation	KR-20	Items Reliability		Empirical Reliability (Bilog)
						Real	Model	
11	24	839	200.01	5.27	0.80	0.98	0.98	0.84
12	24	802	198.39	5.14	0.88	0.98	0.98	0.71
13	31	11,956	212.73	6.62	0.89	0.95	0.96	0.88
14	31	6,893	211.75	6.26	0.83	0.96	0.96	0.82
213	30	355	210.80	4.96	0.77	0.98	0.98	0.78
214	30	653	212.42	5.23	0.81	0.99	0.99	0.86
15	31	8,247	227.36	6.02	0.85	0.96	0.96	0.85
16	31	8,627	226.37	6.04	0.83	0.95	0.96	0.81
215	32	550	222.80	6.66	0.87	0.98	0.98	0.87
216	32	478	223.67	6.27	0.85	0.97	0.97	0.85
17	32	3,144	231.03	6.19	0.85	0.98	0.98	0.85
18	32	2,689	233.28	6.55	0.82	0.98	0.98	0.81

With Rasch IRT models the test information function, a sum of all the item information functions, is a useful tool in measuring the reliability of a test. In general, test information functions tend to look bell-shaped. A highly discriminating test would have a tall narrow information function which indicates that it contributes a large amount of information but over a narrow range. A less discriminating test would have a flatter but wider information function which indicates that it provides less information but over a greater range. Figures g3-1 through g3-12 include test information functions for each of the *ECS Math Assessment* forms. The test information functions for the parallel test forms in the *ECS Math Assessments* are nearly identical in size, form, and structure showing a high degree of consistency between the parallel test forms. The peak of the test information functions is similar for the parallel test forms.

Figure g3-1 Test Information Function – Form 11

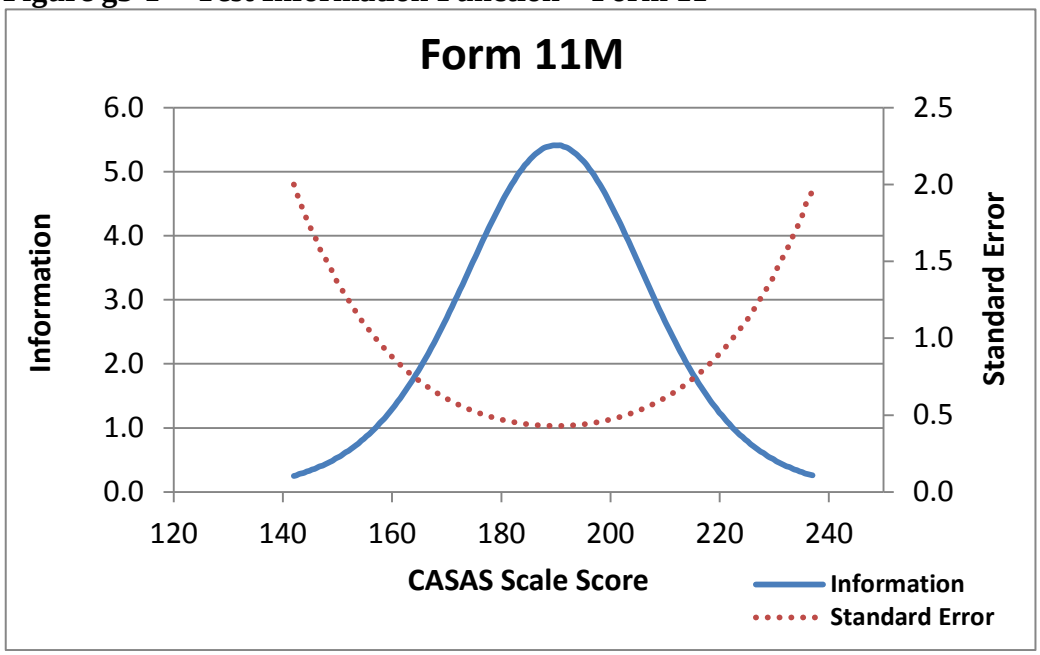


Figure g3-2 Test Information Function – Form 12

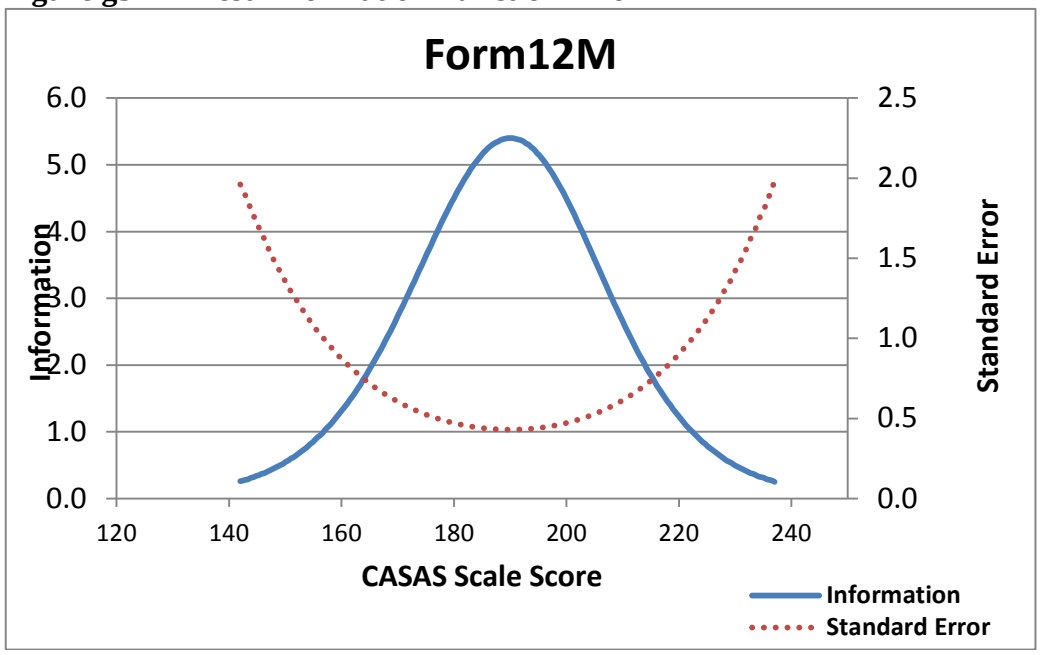


Figure g3-3 Test Information Function – Form 13

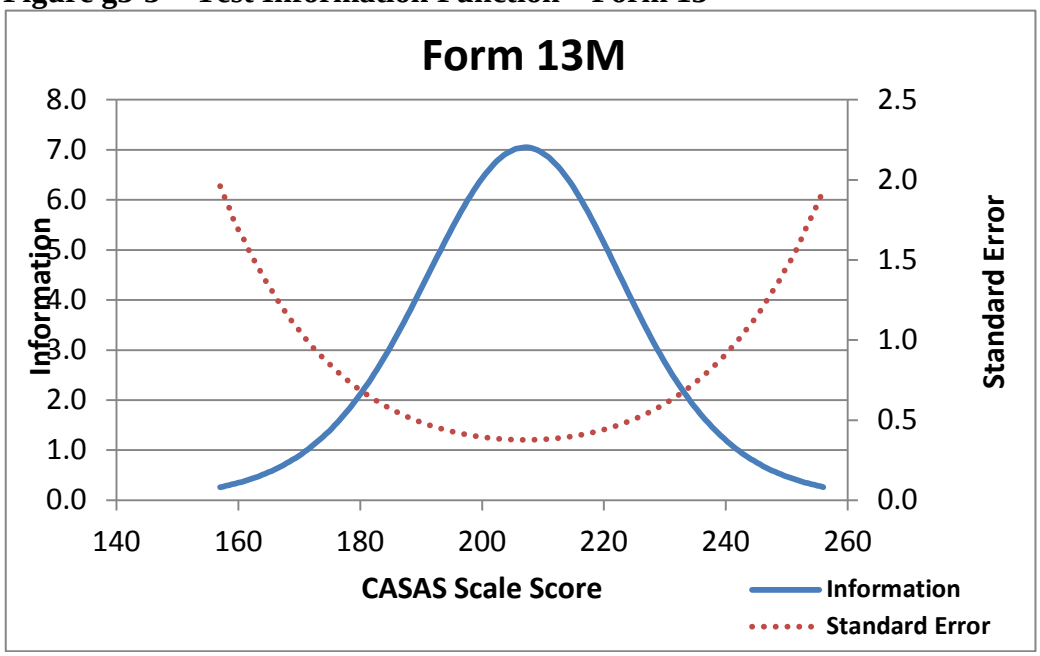


Figure g3-4 Test Information Function – Form 14

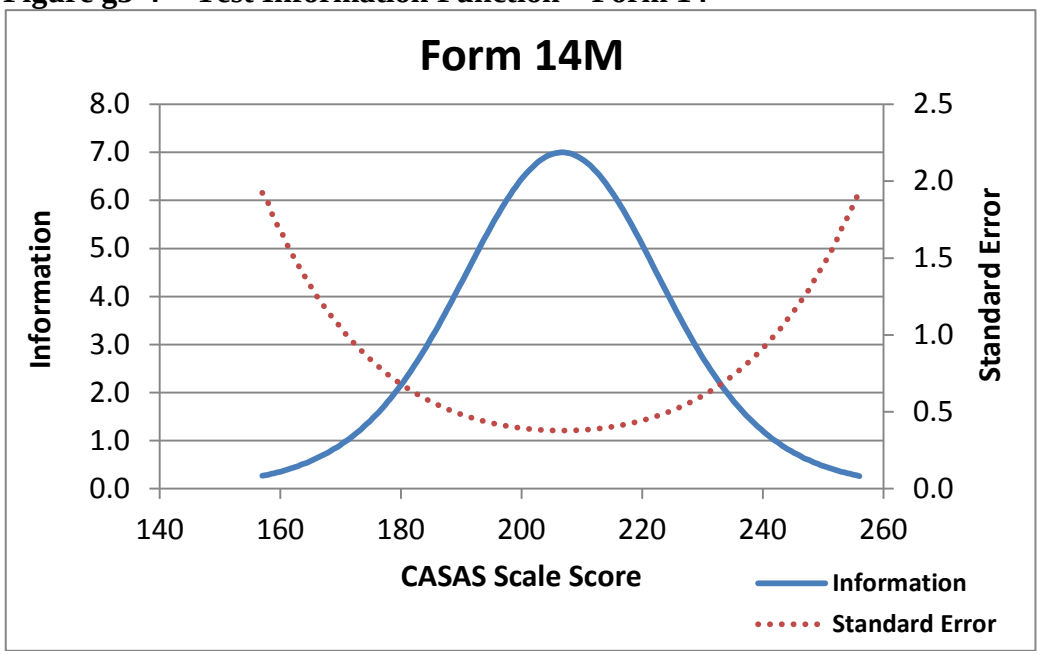


Figure g3-5 Test Information Function – Form 213

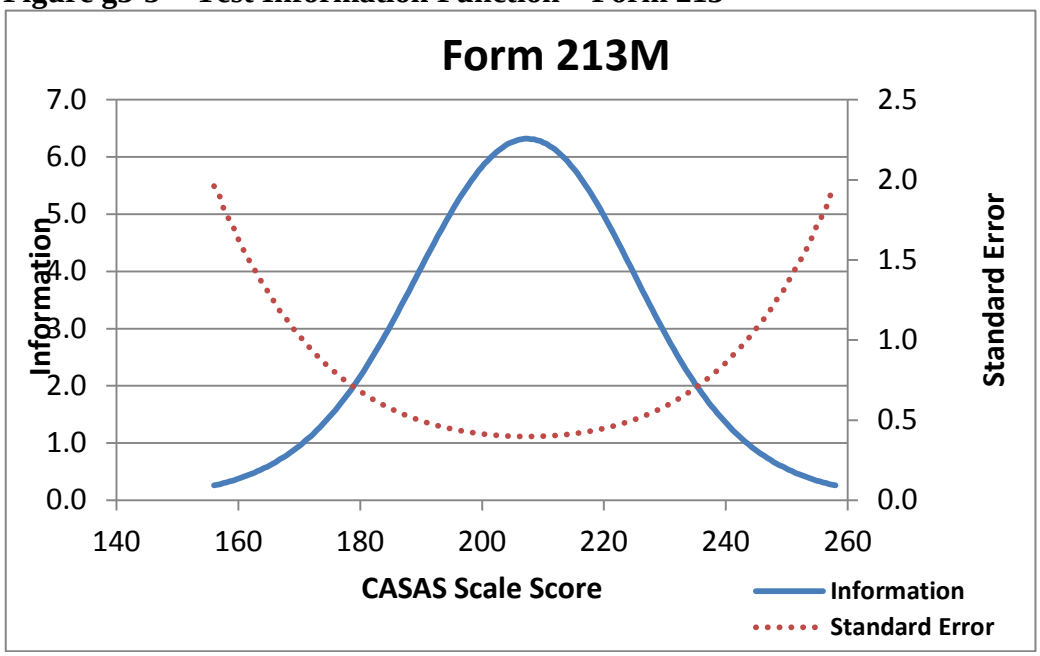


Figure g3-6 Test Information Function – Form 214

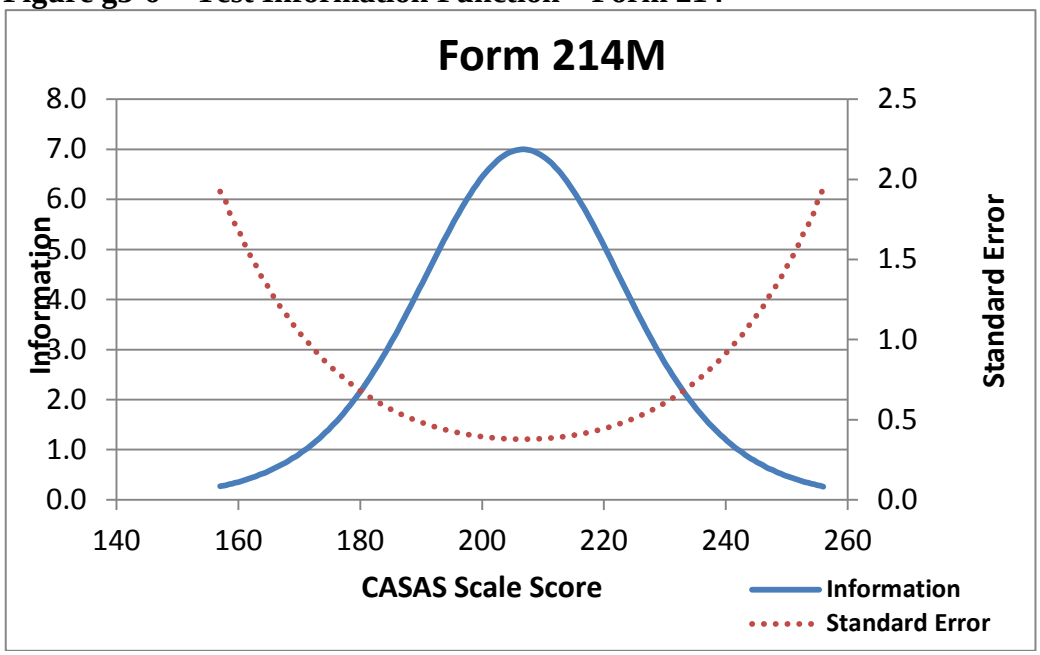


Figure g3-7 Test Information Function – Form 15

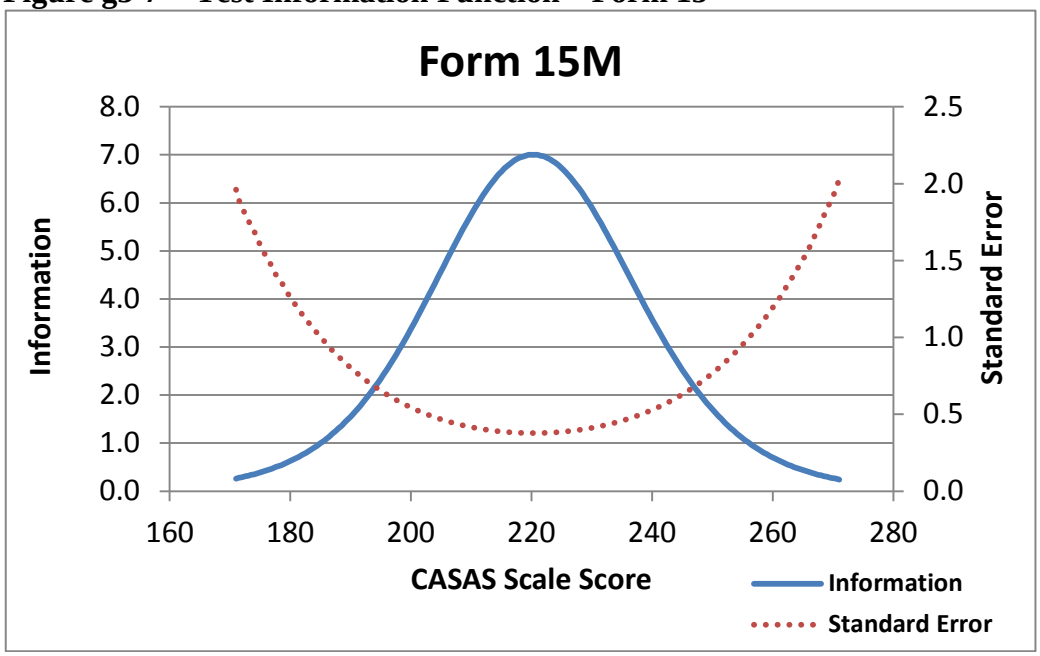


Figure g3-8 Test Information Function – Form 16

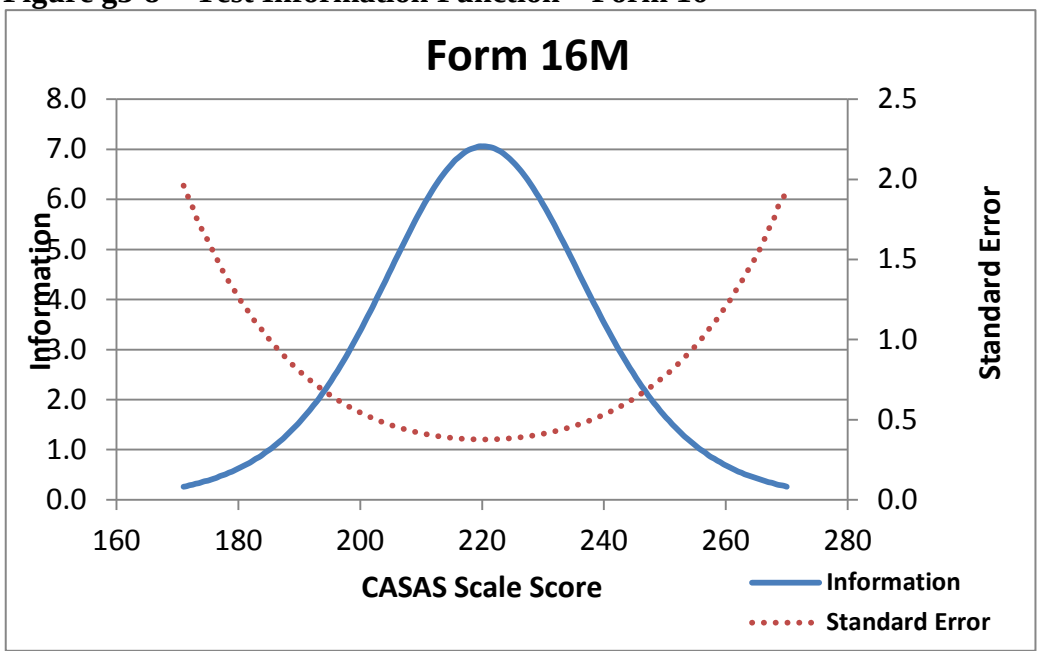


Figure g3-9 Test Information Function – Form 215

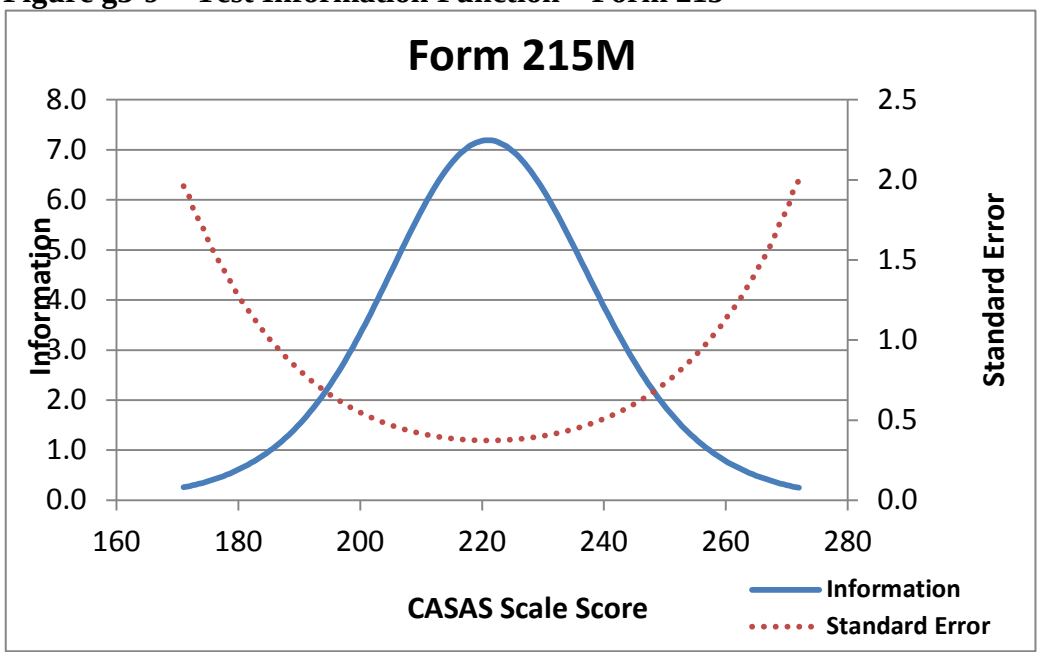


Figure g3-10 Test Information Function – Form 216

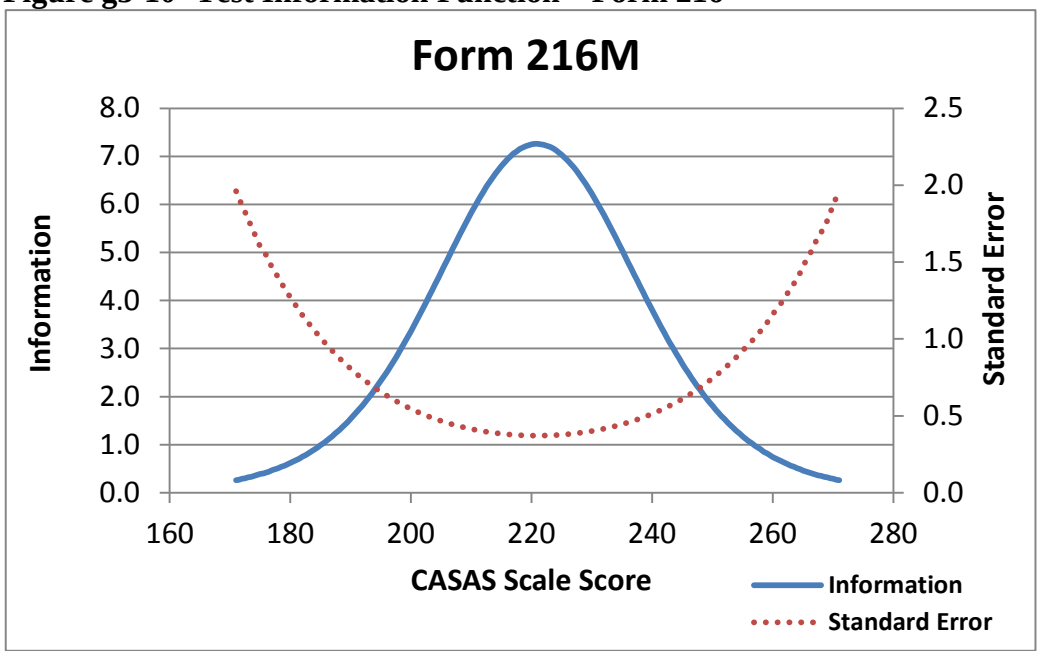


Figure g3-11 Test Information Function – Form 17

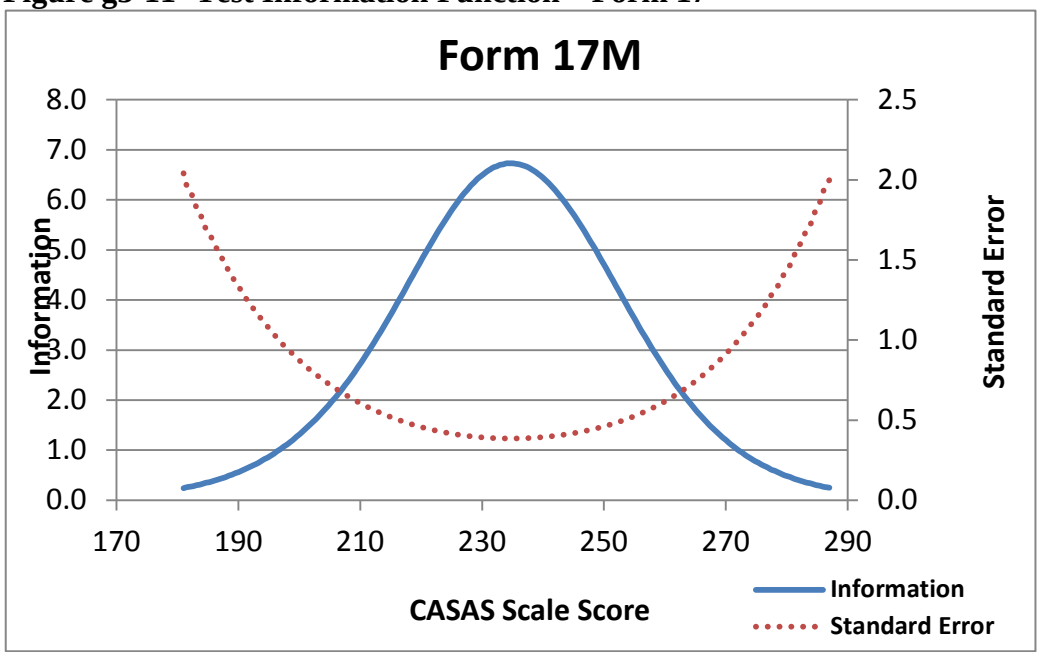
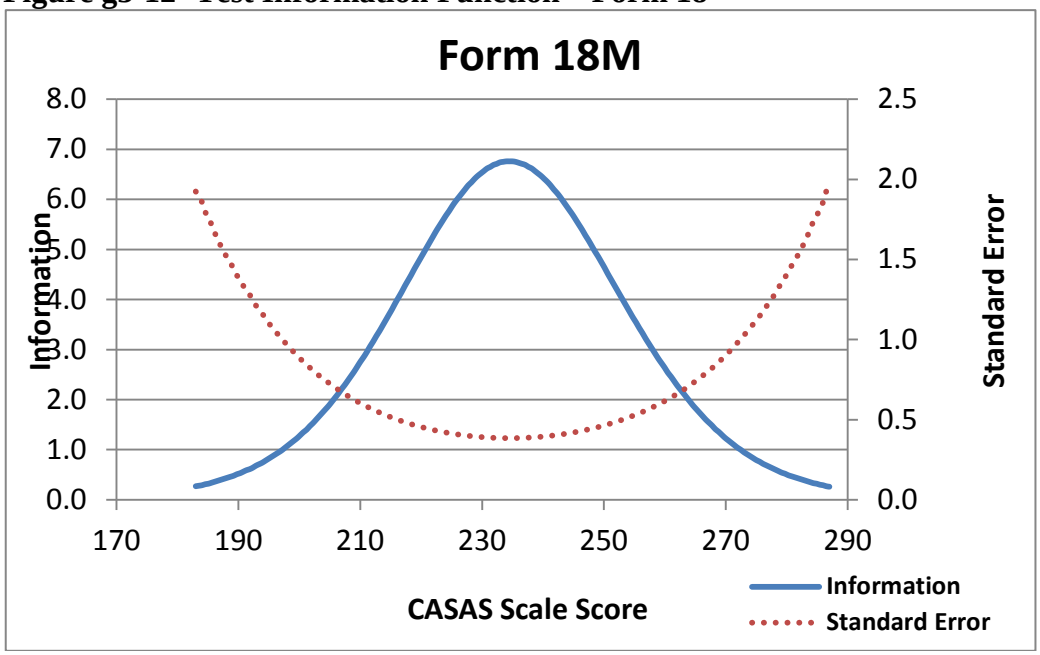


Figure g3-12 Test Information Function – Form 18



As part of the continuing reliability, CASAS is currently conducting Livingston's Coefficient of decision consistency. This is the proportion of score variance surrounding the cut score that is due to true score variance. The higher the value, the more reliable is the positioning of scores on one side or the other of the cut point.

$$K^2(X,T) = \frac{\sigma_x^{\,2}(KR20) + (\mu_x - n_i C)^2}{\sigma_x^{\,2} + (\mu_x - n_i C)^2}$$,where $KR20 = \alpha$, $\sigma_x^{\,2}$ = variance of test scores, μ_x =mean of test scores, and C=criterion level cut score for the test.

One computation for each relevant cut score. Either KR20 or alpha reliability can be used in the formula. The results of this analysis will be reported in a future edition of the technical manual.

(h) Construct Validity. Documentation of the appropriateness of a given test for measuring educational gain for the NRS, i.e., documentation that the test measures what it is intended to measure

Item h1 – The extent to which the raw or scale scores correlate (or agree) with scores or classifications associated with other tests designed or intended to assess educational gain in the same adult education population as the NRS

This Item reports a series of descriptive studies followed by a series of empirical studies.

Relationship between CASAS and GED 2002

The relationship of CASAS to the 2002 official GED Test was examined using data from California, Iowa, Oregon, Kansas, and Hawaii (n = 4,801). In this study CASAS Math and math scores along with official GED test results were collected from the participating states. All individuals had been administered the appropriate CASAS test form within six months of taking the GED test. The sample of adult learners in this study was restricted in range because of the fact that many agencies are reluctant to allow learners to take the GED until they are very likely to pass. However, a clear monotonic increasing relationship was found between CASAS math scores and GED math results. Criteria for passing the GED is a minimum of 410 in each area and an average of at least 450 across five areas – one being math. Table h1-1 shows the relationship between CASAS mean math test scale scores and the GED math scores.

Table h1-1 CASAS Mean Math Test Scores Associated with GED Math Score Ranges

GED Score Range	CASAS Math Test Mean	N	CASAS S.D.
≤400	226	168	8.43
401-425	228	109	8.11
426-449	230	223	7.98
450-476	232	400	9.67
477-494	233	282	8.12
495-510	235	317	8.51
511-524	236	185	7.13
525-540	237	279	7.34
541-556	239	122	7.59
557-576	239	72	9.08
577-600	240	117	7.68
601-638	240	94	8.39
≥639	243	175	7.93

Relationship between CASAS and Other National Reference Scales

The relationship among CASAS levels and score ranges of the National Reporting System (NRS) levels, National Adult Literacy Survey (NALS) levels, Student Performance Levels (SPL), Work Keys levels, and years of schooling completed is provided in Table h1-2.

Table h1-2 Relationship among CASAS, NRS*, NALS, SPL***, Work Keys, and Years of School Completed**

CASAS Levels	CASAS Score Ranges	NRS Levels and Names for ABE	NRS Levels and Names for ESL	NALS Levels	SPL Levels	Work Keys Levels	Years of School Completed
A	180 and below		1 Beginning ESL Literacy	1	1	Below 3	1 to 2
A	181 – 190		2 Low Beginning ESL	1	2	Below 3	1 to 2
A	191 – 200	1 Beginning ABE Literacy	3 High Beginning ESL	1	3	Below 3	1 to 2
B	201 – 210	2 Beginning Basic Education	4 Low Intermediate ESL	1	4	Below 3	3 to 5
B	211 – 220	3 Low Intermediate Basic Education	5 High Intermediate ESL	1	5	Below 3	6 to 7
C	221 – 235	4 High Intermediate Basic Education	6 Advanced ESL	1/2	6	3	8 to 10
D	236 – 245	5 Low Adult Secondary Education		2/3	7	4	11 to 12
E	246 and above	6 High Adult Secondary Education		3	8	4	>12

* National Reporting System (WIA Title II)
** National Adult Literacy Survey
*** Student Performance Levels

CASAS-CAHSEE Readiness Exams

CASAS developed readiness exams to assist WIA Title II adult education agencies in determining the readiness of their learners to take the California High School Exit Examination (CAHSEE). CASAS field-tested readiness exams for both the Math and English Language Arts (ELA) Items of the CAHSEE. Participating adult education agencies administer the CASAS-CAHSEE Readiness exams to examinees one week prior to the CAHSEE exam. Both the math and ELA readiness exams comprise nearly equal number of CASAS and CAHSEE questions.

The CASAS-CAHSEE Math Readiness exams continue to be field-tested in order to increase the number of learners who have taken the exam. To date, 418 learners have taken both CASAS-CAHSEE Math Readiness Exam and the actual CAHSEE. Preliminary results from the CASAS-CAHSEE Math Readiness Exam indicate a strong internal correlation between the performance on the CASAS items and the CAHSEE practice items. In addition, preliminary results also indicate a strong relationship between performance on the CASAS-

CAHSEE Readiness Math Exam as a whole and actual the CAHSEE scores achieved by the learners. These preliminary results are summarized in Tables h1-3 and h1-4.

CASAS will continue to examine correlations between CASAS items and exit level assessments provided by participating states.

Table h1-3 CASAS-CAHSEE Readiness Preliminary Correlation Results

	Correlation	N
CASAS Math Items and CAHSEE Math Practice Items	0.68	418
CASAS Math Items and Actual CAHSEE Math Score	0.60	418

Table h1-4 CASAS-CAHSEE Readiness Preliminary Predicted Pass/Fail Results

NRS Program Levels	CASAS Score Range	n or %	CAHSEE Results		Totals
			Failed	Passed	
Intermediate Adult Basic Education	≤ 224	n	113	26	139
		%	81.30%	18.70%	100.00%
	225-229	n	85	52	137
		%	62.00%	38.00%	100.00%
	230-235	n	23	65	88
		%	26.10%	73.90%	100.00%
Adult Secondary Education	≥ 236	n	4	50	54
		%	7.40%	92.60%	100.00%
	Totals	n	225	193	418
		%	53.80%	46.20%	100.00%

Item h2 – The extent to which the raw or scale scores are related to other relevant variables, such as teacher evaluation, hours of instruction, or other measures that may be used to test performance;

Teacher Evaluation Study

To provide additional external evidence of construct validity, CASAS conducted a concurrent validity study. The goal of this study was to determine the degree to which the placement of examinees into NRS Educational Functioning Levels based on independent teacher evaluations compared to scores achieved on the CASAS math assessments. The use of the teacher evaluations can be interpreted as an independent measure of students' abilities on the same construct measured by CASAS assessments.

For the purposes of this study, CASAS requested the participation of teachers across a variety of adult education classes. Special attention was taken to choose classes of all levels so that the sample population consisted of students who spanned all six of the NRS Educational Functioning Levels and from a variety of forms covering the CASAS math assessment series.

The study took place during the middle of the instructional year so that teachers would have sufficient knowledge of their students' ability. Also, the timing of the study was specifically chosen to coincide with a CASAS testing administration so that students would have recently taken a CASAS test and been placed into a corresponding NRS Educational Functioning Level. It was important that the teachers' judgments were proximate with the assessment, so the estimates of students' abilities were at similar times.

Teachers were educated on the descriptions of the NRS Educational Functioning Levels. In general, teachers' familiarity with these levels was very limited. Because of this limitation, CASAS researchers noted that more advanced training regarding the NRS Educational Functioning Levels might be beneficial for future studies.

Teachers were then asked to place each student into an NRS Educational Functioning Level based solely on their knowledge of students' abilities without consideration of construct irrelevant factors (e.g., motivation, behavior, attendance). If a teacher did not have sufficient contact with a student, they were asked not to evaluate that student. Teachers were specifically instructed to make their evaluation without seeing the score the student had recently achieved on their CASAS test or the corresponding NRS Educational Functioning Level in which this placed them. The goal was to receive teacher evaluations that were not influenced by, and therefore independent of, students' test scores.

The background and demographic information of the participating teachers is listed in Tables h2-1 through h2-5.

Table h2-1 Teacher Evaluation Study – Participating Teachers' Background

Title, Degree(s), Certification(s)	N	%
BA/BS	10	27.0
MA/MS	13	35.1
ESL Instructor	1	2.7
Teacher	3	8.1
Multiple Subject Teaching Credential	1	2.7
Adult Ed. Credential (Designated Subjects)	2	5.4
ABE/GED Instructor	1	2.7
Non-Credit Instructor	1	2.7
Special Education Credential	1	2.7
ABE Teacher, Multi Subject Certification w/Bilingual BCLAD & TESOL Certif.	1	2.7
No Response	3	8.1
Total	37	100.0

Table h2-2 Teacher Evaluation Study – Participating Teachers' Teaching Experience

Years Adult Education Teaching Experience	N	%
<5	7	18.9
5-10	10	27.0
11-15	6	16.2
16-20	6	16.2
21-25	2	5.4
26-30	3	8.1
No Response	3	8.1
Total	37	100.0

Table h2-3 Teacher Evaluation Study – Participating Teachers' Gender

Gender	N	%
Female	23	62.2
Male	10	27.0
No Response	4	10.8
Total	37	100.0

Table h2-4 Teacher Evaluation Study – Participating Teachers' Age

Age	N	%
< 35	4	10.8
35-45	9	24.3
46-59	14	37.8
60+	6	16.2
No Response	4	10.8
Total	37	100.0

Table h2-5 Teacher Evaluation Study – Participating Teachers' Race/Ethnicity

Race/Ethnicity	N	%
White (Not Hispanic or Latino)	23	62.2
Hispanic or Latino	5	13.5
Asian	2	5.4
Black or African American	4	10.8
No Response	3	8.1
Total	37	100.0

Tables h2-6 and h2-7 provide evidence of the agreement, defined as classification consistency, between NRS Educational Functioning Level placement by teachers and by CASAS test scores.

For future studies, CASAS is designing new training methods that will be used to ensure that teachers are adequately trained on the descriptions of each NRS Educational Functioning

Level. This includes allotting more time to this process. In addition, we feel it is important to train teachers to be aware of a possible tendency to use construct irrelevant factors (e.g. behavior, attendance, effort) to evaluate student ability.

Table h2-6 provides the mean CASAS test scale scores by ABE/ASE NRS Level that was assigned through teacher evaluation. For example, for all ABE students that were assigned an NRS Level of Low Intermediate Basic Education by teachers, the mean CASAS test score was 214.1. These results suggest that the teachers, on average, were able to classify students into categories that were also differentiated by their observed scores.

Table h2-6 Mean CASAS Test Scale Scores by NRS Level Assigned via Teacher Evaluation (ABE/ASE)

NRS ABE/ASE Educational Functioning Level	Mean CASAS Test Score	N
Beginning ABE Literacy	--	1
Beginning Basic Education	192.8	13
Low Intermediate Basic Education	214.1	24
High Intermediate Basic Education	223.0	23
Low Adult Secondary Education	232.0	17
High Adult Secondary Education	--	1

Note. Mean scores less than 10 are not reported.

Table h2-7 provides the mean CASAS test scale scores by ESL NRS Level that was assigned through teacher evaluation. For example, for all ESL students that were assigned an NRS Level of High Beginning ESL by teachers, the mean CASAS test score was 208.2. Similar to the results observed in Table h2-7 above, the teachers were generally able to classify students into NRS levels that also demonstrated differences in their observed CASAS scores.

Table h2-7 Mean CASAS Test Scale Scores by NRS Level Assigned via Teacher Evaluation (ESL)

NRS ESL Educational Functioning Level	Mean CASAS Test Score	N
Beginning ESL Literacy	175.5	63
Low Beginning ESL	195.8	82
High Beginning ESL	208.2	38
Low Intermediate ESL	212.5	82
High Intermediate ESL	218.4	130
Low Advanced ESL	224.4	71

CASAS to Degree and Years of Schooling

The results above demonstrate that while CASAS scale scores are not precise equivalents for grade levels completed, there is a clear correlation between the two, and that CASAS scale scores in math on the ECS Series do translate to higher grade levels completed. In Table h2-8 it is also worth noting that the majority of the differences between CASAS means for a grade level completion are significant. Therefore, in general, participants who have more years of schooling score higher in math, indicating a predictive relationship between the test scores and grade level completion.

Table h2-8 Iowa Population Mean Scale Scores by Highest Degree Earned

Highest Degree Completed	Number	% of sample	Reading	Math
None	380	48	232	219
High School	239	30	240	226
GED	121	15	243	228
Vocational/Technical	21	3	246	233
AA/AS	13	1	248	234

Table h2-8 demonstrates the relationship between highest degree completed and ECS Math mean scale scores. The data show that higher reading and math scores translate to higher degree completion rates. The differences between the means for no degree and all other noted degrees were significant at the .05 level, and differences between a high school diploma and all higher degrees (including GED) were significant as well.

An additional study compared ECS math scale scores across six test forms for examinees having six or fewer years of schooling and those examinees having seven or more years. Results of t-test comparisons between the two groups was consistent with earlier studies. Across all test forms analyzed, examinees who have had seven or more years of schooling demonstrated higher scale scores when compared to those having six or fewer years of schooling. This finding was strongest with examinees at the B and C levels compared to those

at the A levels. The t-value and significance values on these forms provide evidence that we can reject the null-hypothesis that the mean scores are similar and accept the hypothesis that the means are different for the two education groups analyzed. The results of the statistical analysis by test level are shown in Table h2-9.

Table h2-9 Mean Pre-Test Scores by Years of Education Completed

Forms	Years Group	N	Mean	Standard Deviation	t Value	SIG.
11M	6 or less	145	199.2	9.97	3.994	0.000
	7 or more	611	202.0	9.46		
12M	6 or less	129	196.7	9.24	2.855	0.004
	7 or more	599	199.0	10.11		
13M	6 or less	403	209.0	10.94	9.738	0.000
	7 or more	11257	213.2	10.94		
14M	6 or less	355	209.0	9.86	7.087	0.000
	7 or more	6254	212.0	10.25		
15M	6 or less	256	224.3	10.57	8.867	0.000
	7 or more	7509	227.7	9.87		
16M	6 or less	419	223.5	10.23	9.940	0.000
	7 or more	7683	226.9	10.01		

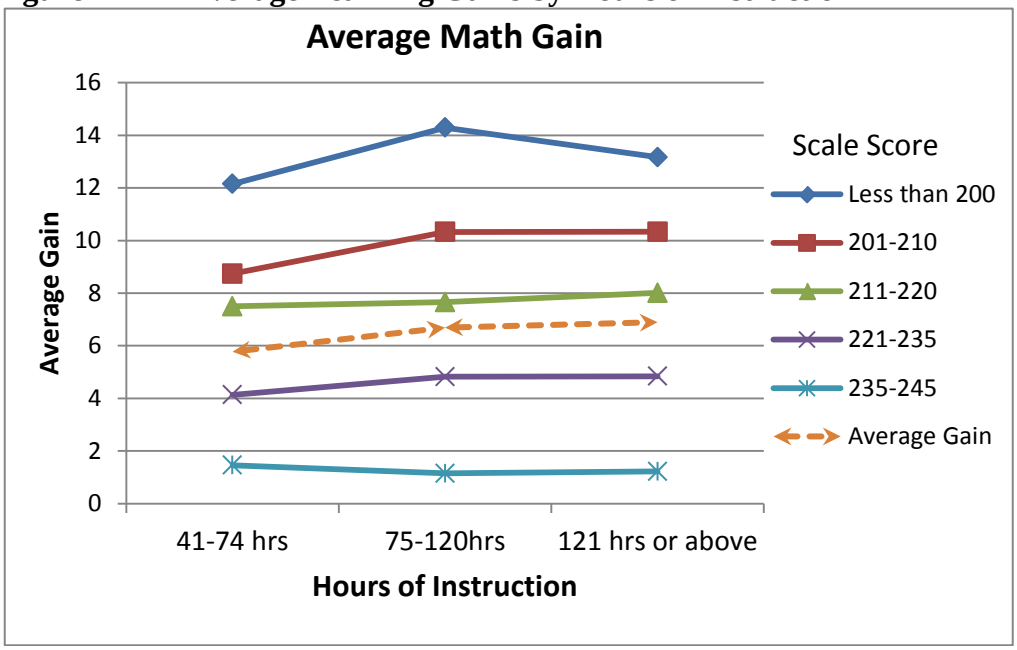
CASAS to Hours of Instruction

The study looked at the relationship between hours of instruction and learning gains. The table and figures below represent combined data from two states: California and Oregon for the program year 2006-07. The data was collected for NRS Federal Table reporting purposes using TOPSpro software. There were 15,043 examinees who took a pre- and post-test using a CASAS math assessment. The data represents five ABE NRS functioning levels. See Table h2-10 and Figure h2-1.

Table h2-10 Study Population – Hours of Instruction and Learning Gains

	Learners with CASAS Math Pre- and Post-test		
Educ. Functioning Level	41-74 Hrs	75-120 Hrs	121 Hrs & above
ABE Beginning Literacy	200	218	560
ABE Beginning	547	526	1,343
ABE Intermediate Low	843	833	2,387
ABE Intermediate High	1,518	1,467	3,544
ASE Low	318	243	496

Figure h2-1 Average Learning Gains by Hours of Instruction



Examinees who took a pretest and post-test on a CASAS math assessment are grouped according to the hours of instruction: 41-74, 75-120, and above 121 hours. It is important to note that the study used the total hours of instruction within a program year as reported for the NRS Federal tables for each student without consideration as to hours specifically devoted to math instruction. Overall, the figure shows a positive correlation between average gain and hours of instruction when looking at examinees with 41-74 hours of instruction and those with above 121 hours. The highest gains between pre- and post-test are seen at the lower levels. Additional research has shown that the positive relationship between hours of instruction and learning gains in the adult education program is mainly seen across instructional levels in the ESL program and does not always hold, especially at the high levels, in ABE and ASE programs. One hypothesis for this is that ESL classes often may have more structure and more consistent attendance patterns.

Unidimensionality and Principal Components Factor Analysis

Fundamental to all IRT models is the notion that a test measures one and only construct. This is referred to as unidimensionality. The assumption is that the items in a test are homogenous and are measuring a single trait. One of the more common and early ways of testing this assumption was through criteria developed by Reckase (1979). Generally, these criteria related to the proportion of variance associated with the first eigenvalue and the ratio of the first to the second eigenvalue. The eigenvalue for a factor measures the variance in all the variables which is accounted for by that factor and the ratio of eigenvalues is the ratio of explanatory importance of the factors with respect to the variables. A factor with a low eigenvalue is contributing little to the explanation of variances in the variable. Thus, eigenvalues measure the amount of variance in the total sample accounted for by each factor. Eigenvalues are computed by summing the squared factor loadings (the correlation between the variable and the factor) for all the variables.

The procedure, proposed by Reckase, for assessing unidimensionality called for generating a tetrachoric inter-item correlation matrix and then conducting a principal components analysis to determine whether the first factor accounted for at least 20 percent of the total variance.

Results showed that the first principal component included the majority of the variance compared to the subsequent principal component extractions across the ECS Math Forms. For example, for Form 11M, 30.1 percent of the variance can be accounted for by the first eigenvalue; and the first eigenvalue is much larger than the second eigenvalue (7.22 compared to 1.50 or a ratio of 4.81). These are indicators, among others, of an essentially unidimensional construct measurement. See Table h2-11 for information on the math forms analyzed separately.

Data from the combined math and reading forms were analyzed using principal components factor analysis. Each set of items was composed of both math and reading items in an adult life skills context. The math and reading item sets were also independently analyzed. Eigenvalues from each principal component were extracted from the data matrix and compared to determine the eigenvalue size and proportion of variance that was accounted for by each of the principal components.

The results also show that the ratio of the first and second eigenvalues (representing the proportion of total variance accounted for by the first eigenvalue compared to the proportion of variance accounted for by the second eigenvalue) was greater for all forms when the math and reading items were analyzed separately than when they were treated as a single form. For example, for Form 11M, 30.1 percent of the variance can be accounted for by the first eigenvalue and for 11M and 11R combined 23.85 percent of the variance can be accounted for by the first eigenvalue. See Table h2-12 for information on the combined math and reading forms.

Table h2-11 Principal Components Factor Analysis

Form	Number of Items	Largest Eigenvalues 1	2	3	% of Variance First Factor	$\frac{\lambda^1}{\lambda^2}$
11	24	7.22	1.50	1.07	30.10	4.81
12	24	3.91	1.93	1.48	16.29	2.02
13	30	7.15	1.77	1.27	23.85	4.03
14	31	5.33	1.83	1.41	17.21	2.91
213	30	4.17	1.52	1.39	13.90	2.74
214	30	4.94	1.56	1.35	16.48	3.62
15	31	6.14	1.46	1.16	19.82	4.20
16	31	5.50	1.48	1.17	17.74	3.71
215	32	6.43	1.46	1.37	20.10	4.40
216	32	5.85	1.86	1.44	18.30	3.14
17	32	5.82	2.21	1.15	18.21	2.63
18	32	5.05	1.70	1.38	15.78	2.97

Table h2-12 Principal Components Analysis – Combined Forms

Form	No. of Items	Largest Eigenvalues 1	2	3	% of Variance of First Factor	$\frac{\lambda^1}{\lambda^2}$
11	49	11.69	3.15	2.28	23.85	3.72
12	49	7.05	2.64	2.30	14.37	2.68
13	65	15.28	3.82	1.94	23.51	4.00
14	65	10.40	3.62	2.28	15.99	2.87
15	69	10.00	2.96	1.87	14.49	3.38
16	69	10.20	2.95	1.60	14.78	3.46
17	62	10.18	3.15	1.56	16.42	3.23
18	62	8.86	2.99	1.70	14.29	2.96

Item h3 – The adequacy of the research designs associated with these sources of evidence

The series of descriptive and empirical analyses listed in Items h1 and h2 involved the collaboration of psychometric experts, subject matter experts, and data collection experts in the field of adult education. A detailed summary of the results of each study is included in Items h1 and h2.

The research designs for each project focused on the proper selection of the study population to ensure adequate representation of the adult education population being served. Item h3i details the size of the study populations associated with the research designs, and Item h3ii presents the demographic characteristics of the study population. In the Relationships

Between CASAS and MELT, Work Keys Study, and the CASAS-GED Correlation Study, multiple states participated in the studies, allowing for a broader representation of the entire adult education population.

In the empirical analyses Mean Scale Scores by Years of Education, Mean Scale Scores by Hours of Instruction, and the Unidimensionallity and Principal Components Analysis, CASAS used data submitted by WIA Title II funded agencies from examinees, encompassing examinees in California during the 2004-05, 2005-06 and 2006-07 program years. CASAS is responsible for the collection and aggregation of these submissions via the TOPSpro™ (Tracking of Programs and Learners) software. The data collection process follows strict guidelines to ensure accuracy and uniformity. This begins with the training process on data collection requirements and techniques for test administrators and scorers, detailed in Item i4, and continues as the data received by CASAS is then subject to rigorous data quality checks. These data quality checks are based on the Data Quality Checklist published by the NRS. Examples include a comprehensive data dictionary provided to all local programs and the review of data on a quarterly basis using error checking functions that identify out-of-range values, anomalous, or missing data.

The research designs for each study take into consideration and can be described by five "elements" of research design: observations or measures, treatment or programs, groups, assignment to group, and time (Trochim, 2006). The layout design for the empirical data analyses generally follows the example outlined in Table h3-1 and Figure h3-1.

Table h3-1 Research Design Summary for Hours of Instruction by Learning Gains Analysis

Observations/Measures:

The first measure is the pretest score for examinees who took a pretest during a given program year(s). The second measure is the post-test score for examinees given a post-test during the same program year(s).

Treatment or Programs:

The treatment is the instruction given between the pretest and post-test.

Groups:

The data is grouped into three subgroups: examinees with 41-74, 75-120, or 120+ hours of instruction between pre- and post-tests.

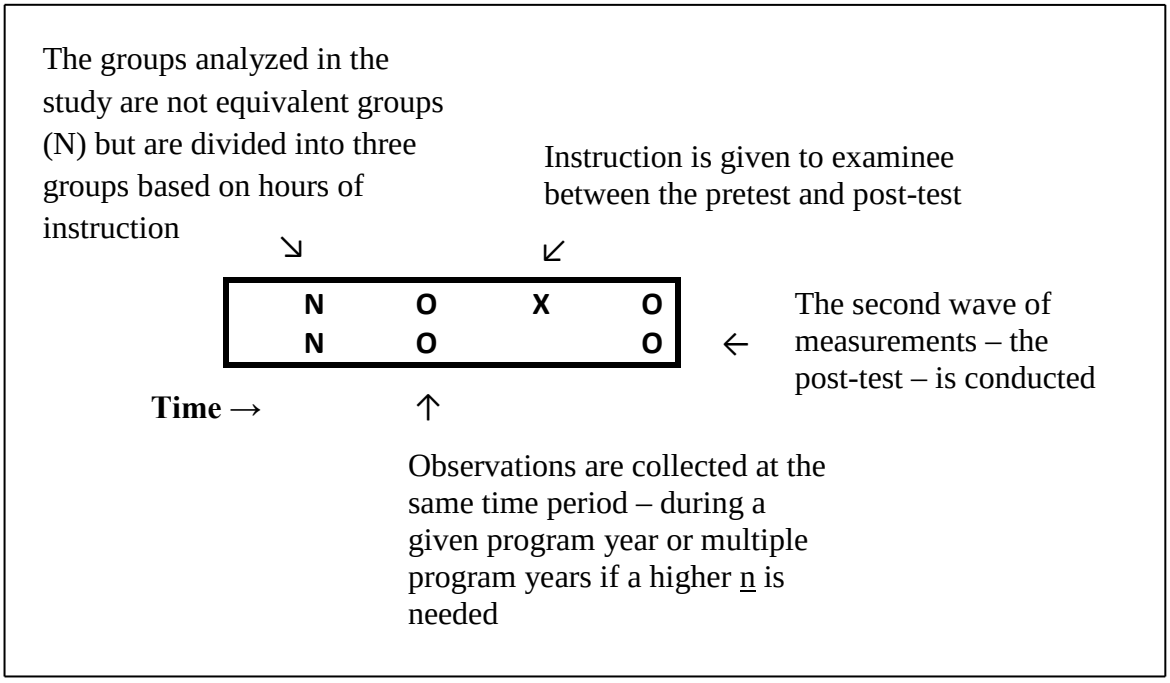
Assignment of Groups:

The two groups are not equivalent (N) and are assigned based on hours of instruction.

Time:

Time moves from left to right in Figure h3-1 showing that once the groups are identified, the mean learning gains are then calculated and analyzed.

Figure h3-1 Research Design Notation for Hours of Instruction by Learning Gains Analysis



Item and test form data is further reviewed by psychometric experts to determine if items and test forms conform to psychometric standards such as unidimensionality, inter-item consistency (KR 20), model fit, differential item functioning, standard errors of measurement, etc. When items do not appear to meet professional psychometric standards, they are reviewed again by psychometric and subject matter experts for possible elimination, revision, or retention of the items. After items are calibrated, reviewed, and included on test forms, a raw to scale score transformation is calculated and linked back to original scale. Only scale scores with a conditional standard error of measurement (CSEM) less than 5.6 are included in the accurate range of each test form (see Item d2).

In addition, when conducting analyses such as those included in Items h1 and h2, psychometric experts review all data to determine if further controls are necessary based on the specific data analysis. For the purpose of these analyses, any exams with scores that did not fall in the accurate range with a CSEM less than 5.6 (see Item d2) were eliminated. The access to this robust dataset from a complete population of examinees, collected based on strict standards and procedures that CASAS follows, allows for a high level of confidence in the results.

CASAS continues to conduct research related to construct validity. CASAS regularly updates analyses, such as the Mean Scale Scores by Years of Education, with current program year data and reviews its items and tests for item difficulty drift, bias, sensitivity, and current relevance. For analyses that are still in progress, such as the CASAS-CAHSEE Readiness Study, additional data collection continues to further increase the reliability and validity of the results.

(h3i) The size of the samples

Table h3i-1 Construct Validity Research Studies Information

Study	Participants	Table
Teacher Evaluation Study	37 teachers from 15 agencies	h2-1 – h2-7
Work Keys Study	494 learners from 27 sites across 8 states	h1-2
CASAS-GED Correlation Study	2,543 learners from five states	h1-1
CASAS-CAHSEE ELA Readiness Study	418 learners from 76 agencies	H1-3, h1-4
CASAS-IOWA Study Examining Mean Scale Scores by Highest Degree Completed	774 learners	h2-8
Mean Scale Scores by Years of Education	35,620 examinees	h2-9
Mean Scale Scores by Hours of Instruction	15,043 examinees	h2-10, Figure h2-1
Unidimensionallity and Principal Components Analysis	45,233 examinees	h2-11, h2-12

(h3ii) The similarity between the sample(s) used in the data collection and the adult education population

As outlined in Item h3i, several of the studies included participants from a wide variety of agencies and states to represent better the diversity of the adult education population.

For the Mean Scale Scores by Years of Education and the Unidimensionallity and Principal Components analyses, please refer to Table c1i-1 that reports overall demographic characteristics on the populations used in these analyses. The N may vary slightly when different controls are implemented, such as analyzing scores only in the accurate range and adding 2006-07 program year data to increase the sample size for specific forms. The demographic characteristics did not change significantly based on these additional controls.

(h3iii) The steps taken to ensure the motivation of the examinees

When field tests were administered, the test administration directions were provided and reviewed with participating agencies. Item 2 from the Field-test Administration Directions specifically states:

> Explain to learners that we are making a new Math test. Today we are going to find out how well the test works and if the questions are right for your level.

Prior to administration of the test forms, administrators emphasized to the examinees the importance of doing their best on the test and answering the questions to the best of their ability, but not to guess at answers just to finish the test. Test administrators explained to examinees the important role they play in the creation of a new test.

Other analyses, such as the CASAS-GED Correlation Study, the CASAS-IOWA Study Examining CASAS Scale Score and Grade Level, the CASAS-IOWA Study Examining Mean Scale Scores by Highest Degree Completed, and the Mean Scale Scores by Years of Education Study were conducted as continuing validity studies and use actual aggregated student pre- and post-test data administered during the course of regular classroom instruction and assessment.

Item h4 – Other evidence demonstrating that the test measures gains in educational functioning resulting from adult education and not from other construct irrelevant variables such as practice effects

Additional construct-related analyses were needed to determine if the *ECS Math Assessments* were adequately measuring only the intended construct.

Confirmatory Factor Analysis

The ECS Assessments include both math and reading problem solving item scores. Data from the *ECS Math Assessments* were analyzed using confirmatory factor analysis to determine if the combined math and reading item scores were better fit with a one-factor model or a two factor model. The one-factor model hypothesized a single construct of adult life skills problem solving for the combined math and reading item scores. The two-factor model evaluated separate constructs for the math and reading item scores. Multiple statistical indicators of model fit were computed to measure the goodness of fit of the one- and two-factor models.

The Goodness of Fit Index (GFI) is a measure of the proportion of variance and covariance that the hypothesized model is able to explain, while the Adjusted Goodness of Fit Index (AGFI) considers the degrees of freedom in computing the measure. The Root Mean Square Residual (RMR) is an average of the residuals between observed and estimated input matrices. The Root Mean Square Error of Approximation (RMSEA) is a comparative fit measure that reflects the extent that the proposed model does not fit the data. In summary, for the GFI and AGFI, a higher index shows a better fit to the model. For the RMR and the RMSEA, a lower index shows a better fit to the model.

Table h4-1 provides results from the confirmatory factor analysis for the odd numbered forms in the ECS series. These results show that for the ECS Series the hypothesized two factor model (separate math and reading construct item score factors) has a consistent better fit to the empirical score data than the one-factor model (hypothesizing a common factor or construct for adult life skills problem solving but not differentiated into the math and reading groups).

Table h4-1 Confirmatory Factor Analyses

Form N Factors Reading and Math	GFI One	GFI Two	+/-	AGFI One	AGFI Two	+/-	RMR One	RMR Two	+/-	RMSEA One	RMSEA Two	+/-
11	.76	.86	+.10	.74	.89	+.15	.12	.08	-.04	.08	.09	+.01
13	.45	.68	+.23	.41	.66	+.25	.11	.07	-.04	.14	.09	-.05
15	.58	.81	+.33	.55	.80	+.25	.07	.05	-.02	.10	.06	-.04
17	.86	.90	+.04	.85	.90	+.05	.09	.08	-.01	.05	.04	-.01

Raw Score Correlation Analysis

To examine further evidence of construct validity, the correlation between ECS Math and ECS Reading scores was analyzed. The study group consisted of all examinees who took both an ECS Math form and an ECS Reading form from the same level (for example, a ECS Math Form 11 and Reading Form 11). Table h4-2 provides the mean raw combined score (the sum of the mean math score and mean reading score), the standard deviation, and the correlation between the math and reading raw scores. Of the eight correlations between the math and reading raw scores that were run for this analysis, only one was above .60. The results provide evidence that the math and reading adult life skill items were not measuring the same construct.

Table h4-2 Raw Score Correlation Analysis

ECS Forms	# of Reading Items	# of Math Items	N	Combined Math and Reading Mean Score	Combined Standard Deviation	Correlation
11	25	24	97	25.4	8.82	0.66
12	25	24	114	26.9	7.63	0.41
13	34	31	1,501	34.0	13.44	0.47
14	34	31	850	36.2	12.37	0.38
15	38	31	2,639	43.8	12.77	0.58
16	38	31	1,982	41.9	12.97	0.53
17	30	32	1,513	32.5	12.39	0.57
18	30	32	922	30.5	10.54	0.38

Parallel Form T-Test Analysis

Additional evidence of construct validity is provided from the results of the Parallel Form T-Test Analysis. For this analysis, the same group of examinees was used as in the Correlation between Parallel Forms Analysis reported under requirement g1. This dataset consisted of examinees who were assessed with each of two parallel forms within a specified time period. The purpose of this analysis was to determine if the mean scores achieved by these examinees on each of the two parallel forms were significantly different.

For the purpose of this analysis, the parallel form administrations were divided into two random groups, so that the test-taking patterns were comprehensive and did not always measure the same administration pattern (for example, to ensure that the first comparison group did not always reflect examinees taking Form 11 and the second group did not always reflect examinees taking Form 12).

The results, comparing the mean scale scores, show low t-values. This provides evidence that we can accept the null hypothesis that the mean scores on parallel test forms at each CASAS test level are not significantly different. These results appear in Table h4-3.

Table h4-3 Parallel Forms T-Test Results

CASAS Test Level	Mean Group 1	Mean Group 2	N	T-Value	Sig.
A	202.69	202.88	85	-0.336	0.738
B	210.80	210.84	1,070	-0.168	0.867
C	227.81	227.73	1,143	0.296	0.767
D	235.06	234.57	293	1.111	0.267

(i) Other Information

Item i1 – A description of the manner in which test administration time was determined, and an analysis of the speededness of the test

Test Administration Times

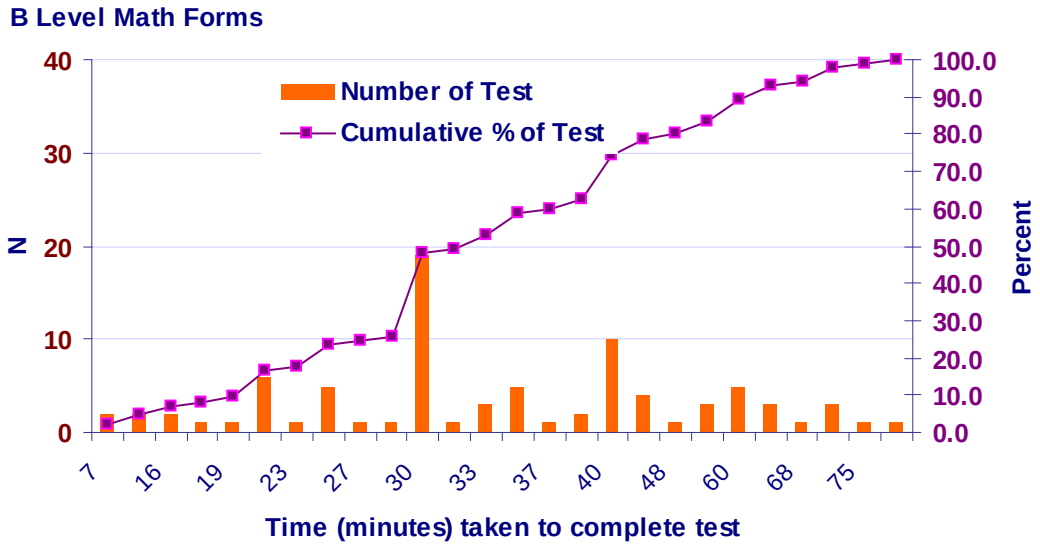
There is no time limit for the *ECS Math Assessments*, but most examinees finish within one hour. From October to December 2007, CASAS conducted a study to analyze the relationship between test-taking time and student performance. Participating test administrators volunteered to record the amount of time examinees took to complete their assessments by writing the beginning and ending times and then recording the total test-taking time on the answer sheets. The answer sheets were then scored and a correlation analysis was run between test-taking time and test score. The results, summarized in Table i1-1, showed no significant correlation between test-taking time and the scores achieved. Typically examinees with lower ability took longer to finish the test and, hence, a negative correlation is expected.

Table i1-1 Test Taking Time and Student Performance – Correlation Analysis

Form Level	CASAS Scale Score	Total Number of Test N	Correlation between test score & time
A	200 or Below	5	-0.099
B	201-220	85	-0.102
C	221-235	330	0.033
D	236-245	240	0.151

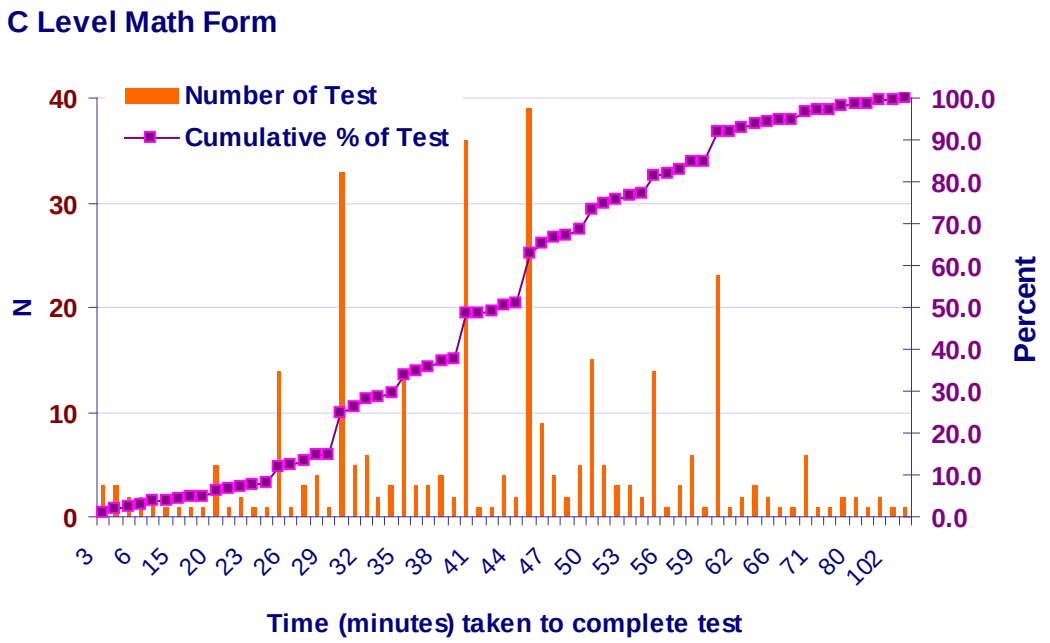
Figures i1-1 through i1-3 display the distribution of the total number of minutes to complete the test. Nearly 80 percent of 85 learners who were administered a B level form took 45 minutes to complete the test. The cumulative percent is shown on the secondary X axis.

Figure i1-1 Test Taking Time for B Level Math Forms



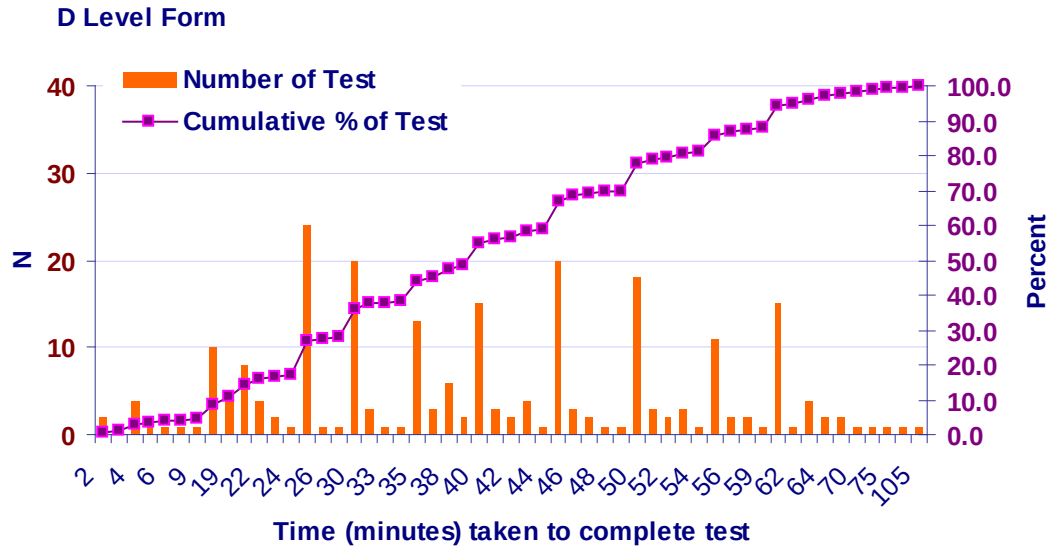
Eighty percent of 330 learners who were administered a C level form took 55 minutes to complete the test

Figure i1-2 Test Taking Time for C Level Math Forms



Eighty-five percent of 240 who were administered a D level form took nearly 55 minutes to complete the test.

Figure i1-3 Test Taking Time for D Level Forms



Item i2 – Additional guidance on the interpretation of scores resulting from any modifications of the tests for an individual with a disability

The following guidelines are published for providing accommodations using CASAS assessment for learners with disabilities:

Local Agency Responsibility

Local agencies are responsible for providing fully accessible services and for ensuring that these services meet reasonable criteria. Adult learners with disabilities are responsible for requesting accommodations and for submitting documentation of their disability at the time of registration, program entry, or after diagnosis. The need to use an accommodation should be documented in official learner records, such as the Individual Education Plan (IEP) or Individualized Plan for Employment (IPE). The documentation must show that the disability interferes with the learner's ability to demonstrate performance on the test. The information can come from a doctor's report, a diagnostic assessment from a certified professional, and other clinical records. Adult agencies can often contact the local division of vocational rehabilitation or a secondary school to request documentation of a disability.

Accommodations in Test Administration Procedures

Local test administrators may provide or allow some accommodations in test administration procedures or environment for documented disabilities without contacting CASAS. Test administrators often use these same strategies as *test taking strategies* for other learners who do not have documented disabilities. Examinees may request to take only one test per day or to test in an alternate quiet room. Examinees may also use a variety of strategies when they take a test, such as a plain straight-edge ruler, magnifying strips or glass, colored overlays, ear plugs, and other devices as deemed appropriate (www.acenet.edu/calec/ged/).

Sample accommodations in test administration procedures or environment are shown in Table i2-1. Examples of these accommodations are extended time, supervised breaks, sign language interpreter (*for test administration directions only)* and magnifier. *Reading* the test is not an appropriate accommodation. The accommodations listed are suggestions only. Accommodations are based on needs of individual learners who have documented disabilities and must be consistent with documentation in the annual plan, such as an IEP. Contact CASAS for more information on other accommodations for documented disabilities.

Use of Appropriate CASAS Test Forms

It is important to use an appropriate test form that best meets the examinee's goals and manner of receiving and reporting information. Most learners with a disability can take some form of a CASAS test. CASAS is able to provide large-print versions of all tests. Large-print tests and computer-based tests are examples of test forms often used for those with documented disabilities based on need. The *ECS Math Assessments* are available in large-print forms and in computer-based delivery of the assessments.

Table i2-1 Accommodations in Test Administration Procedures

Disability	Test Administration Procedures	CASAS Test Forms Available
Specific Learning Disability and/or ADHD such as dyslexia, dyscalculia, receptive aphasia, hyperactivity, written language disorder, attention deficit disorder	Extended time Alternate schedule Frequent breaks Scribe/writer/alternate room Computer — spelling and grammar check disabled Simple calculator for Level A/B only	Large-print tests
Deaf or Hearing Impaired	Sign language interpreter for test directions only Head phones for those taking a listening test	
Blind or Visually Impaired	Magnifier	Large-print tests Computer-based tests
Mobility impairment	Extended time Alternate site/equipment Scribe/writer/ communication board	
Psychiatric Disability such as schizophrenia, major depression		
Developmental Disability such as autism, cerebral palsy, epilepsy, mental retardation		

Item i3 – The manual provided to test administrators containing procedures and instructions for test security and administration

The *ECS Math Assessments* Test Administration Manual (TAM) is included as an attachment. It includes information for administering *ECS Math Assessments*.

Item i4 – A description of the training or certification required of test administrators and scorers by the test publisher

To ensure the accurate administration of tests and the consistent interpretation of test results for each examinee, all agencies that use the CASAS system must complete CASAS Implementation Training. Depending on the particular assessments that an agency chooses, Implementation Training may be four to six hours long.

Throughout the Implementation Training workshop, participants learn standardized test administration procedures, take a sample CASAS test themselves, score and interpret their test results, identify appropriate instructional materials based on test results, and complete a

variety of additional activities. These activities include a case study that follows a student from initial intake and pretesting through the post-testing process.

Implementation Training workshops are conducted by CASAS certified trainers who have completed a series of detailed steps to become state or national-level trainers. These steps are outlined in the Facilitator and Trainer Classifications form and include observing multiple trainings, co-training with a state or national-level trainer and, as a final step, conducting training while being observed and evaluated by a CASAS national-level trainer. States that implement CASAS on a statewide basis maintain their own certified trainers and track those who have completed Implementation Training.

CASAS offers several venues for local providers to attend training. CASAS can send a certified trainer to the provider's agency, agency staff can come to CASAS, or staff can attend the CASAS National Summer Institute held each June. Smaller, rural agencies have a distance-training option offered via CD-Rom or through an online meeting center. The distance-training option is also widely used as an ongoing staff development tool for agencies that use the CASAS system.

Local providers who have completed Implementation Training and have questions about test administration or related matters receive ongoing, complimentary technical assistance through the CASAS 800 number. CASAS assessment specialists are always available to answer questions as a follow up to training.

At the completion of all training workshops, attendees complete a CASAS Training Verification form collected by CASAS. Information about each attendee is entered into the CASAS training database to ensure that only those who have met training requirements are eligible to obtain and administer CASAS assessments

Item i5 – A description of retesting (e.g., re-administration of a test because of problems in the original administration such as a test taker becomes ill and cannot finish, there are external interruptions during testing, or there are administration errors) procedures and the analysis upon which the criteria for retesting are based

The following is the CASAS re-testing policy for the *ECS Math Assessments*:

CASAS Retesting Policy Statement

The re-administration of a test may be necessary because of problems in original administration that can include student illness, external disruptions, or administration errors. Although such events may be infrequent, CASAS has an established assessment policy to mitigate these circumstances. CASAS recommends that learners who experience any of these events will need to repeat the testing procedure. CASAS advises that these learners be administered the alternate form of the test in progress at the time of the disruption. For example, a student in the process of taking an Employability Competency System (ECS), Form 13 Level B Math test during the disruption should, upon returning to the testing situation, take the alternate form of this test: ECS, Form 14 Level B Math. The parallel forms that comprise the *ECS Math Assessments* are constructed so that the two forms can be used

independently of each other and are considered equivalent measures. The items within the parallel forms contain comparable content to reflect the same construct.

The same policy applies to examinees who take a CASAS computer-based test (CBT).

Test administrators should not retest learners on the same day that the disruption occurred. Retesting should occur at least 24 hours after the original test disruption event.

Future Development

Development of a new CASAS math series is underway. The content of this series will be based on priority competencies and content standards determined through a continued collaboration among the test developers, adult educators, learners, and adult education mathematics experts.

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