SMc Curriculum Piloted Local Assessment Option

Spring 2013

Assessment Development

Purpose:

In Oregon, students in the graduating class of 2014 and beyond are asked to meet the Essential Skill in Mathematics: "Apply mathematics in a variety of settings." The goal of the Mathematics Essential Skill is better defined as proficiency in the following three components:

- Interpreting a situation and applying workable mathematical concepts and strategies, using appropriate technologies where applicable.
- Producing evidence, such as graphs, data, or mathematical models, to obtain and verify a solution.
- Communicating and defending the verified process and solution using pictures, symbols, models, narrative or other methods.

Students have the opportunity to show mastery of the Essential Skill in a variety of ways including the state assessment (OAKS or Smarter Balanced), SAT, ACT, work samples and a variety of other options (Appendix A). One of those options is the Local Assessment Option. OAR 581-022-0615: Assessment of Essential Skills, as revised in June 2011, defines the process for districts that choose to develop and administer a local assessment option for students to demonstrate proficiency in the Essential Skills.

SMc Curriculum, in collaboration with McMinnville School District and Pendleton School District, has developed a Local Assessment Option to meet the needs of students who have not passed other assessment options in mathematics. This document describes the assessment structure, item types, pilot process and the process used for setting a cut score.

Standards Alignment:

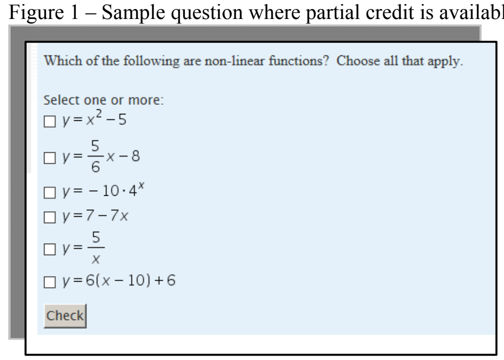
This local assessment was developed based on the overlap of the 2009 Oregon High School Math standards and the assessable 2010 High School Common Core State Standards (CCSS) of Mathematics (see Appendix B for standards assessed). Students in the Classes of 2014 and 2015 will not be assessed on CCSS content so will not be held accountable to these standards for essential skills on this assessment.

The Common Core State Standards become assessable content for the Class of 2016. Additional questions will be piloted and added to this local assessment option in future years to align it to state requirements. See Appendix C for the roll-out of the standards changes on this assessment.

Content:

The overall assessment score is based on 40 items. Each item is worth 10 points for a total of 400 points on the assessment. Some item types (Figure 1) allow students to receive partial credit for answering one or more parts correctly.

Figure 1 – Sample question where partial credit is available



The test consists of three overall domains. Figure 2 shows the breakdown in number of items, points possible and weight for each domain.

Figure 2 – Domain Weights

Domain	Number of Items	Number of Points	Percent/Weight of Test
Algebra	20	200	50%
Geometry	12	120	30%
Statistics & Probability	8	80	20%

Item Types:

A variety of item types are used in the assessment to best match the Smarter Balanced assessment that students will be assessed with beginning in 2014/15. The assessment item styles include, but are not limited to, three- to five-choice selected response questions with one correct answer (Figure 3), selected response with more than one correct answer (Figure 4), fill in the blank (Figure 5), and constructed response (Figures 6 and 7).

Figure 3

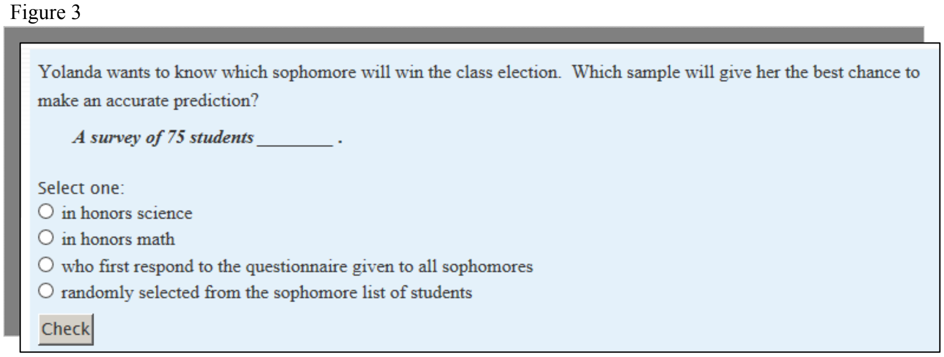


Figure 5

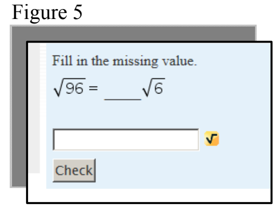


Figure 4

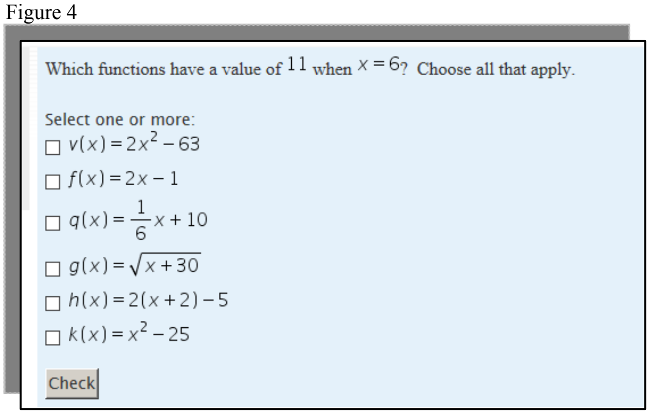


Figure 6

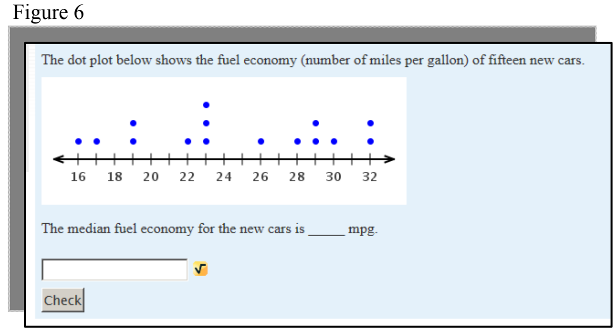
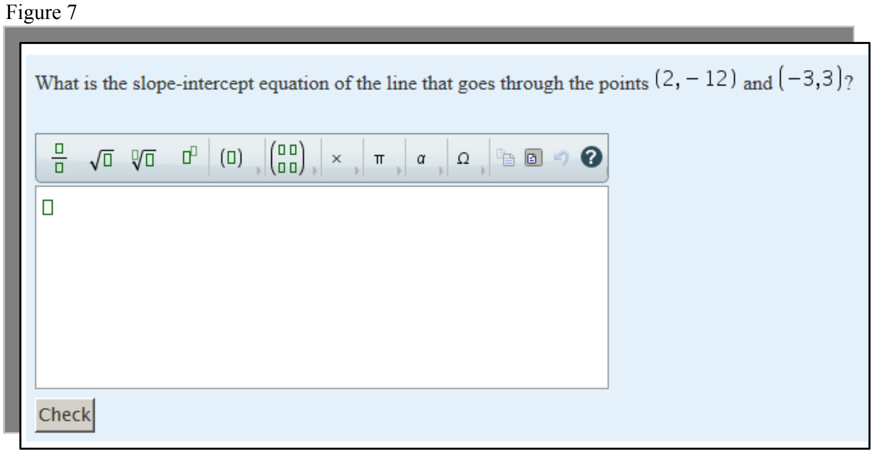


Figure 7



At this time, all items on the assessment are computer scored to give objective feedback to students, parents and schools. Extended response items that mirror the style of Claim 2 and 3 on the Smarter Balanced Assessment may be added in future years during the transition to the Common Core State Standards.

The assessment items are non-static. This means that each time the assessment is administered, unique questions and answer choices are generated for individual students. Also, the question bank includes more than 150 questions. For the pilot, each student's assessment included random questions per the weighted domains so that not all students attempted the same set of questions.

Pilot Process

Description of Participants

In May and June of 2013, over 390 students completed a pilot assessment in the McMinnville and Pendleton School Districts in Oregon. The following characteristics are true of each pilot student:

- Oregon high school student (freshman, sophomore or junior)
- Had a previous best OAKS score between 221 and 254
- Enrolled in a high-school level math class

During the assessment, students were allowed to use OAKS-assessable manipulatives, technology and formula sheet. Students were each given one attempt on the assessment. There was no time limit on the assessment.

The data for 390 students was collected. This data was examined and students were removed from the data set for any of the following reasons:

- student effort (length of time it took the student to take the test < 10 minutes)
- students who did not complete the test
- students who had technical difficulties which they (self-reported) stated affected their results
- teacher feedback on students who they felt did not take the pilot assessment seriously.

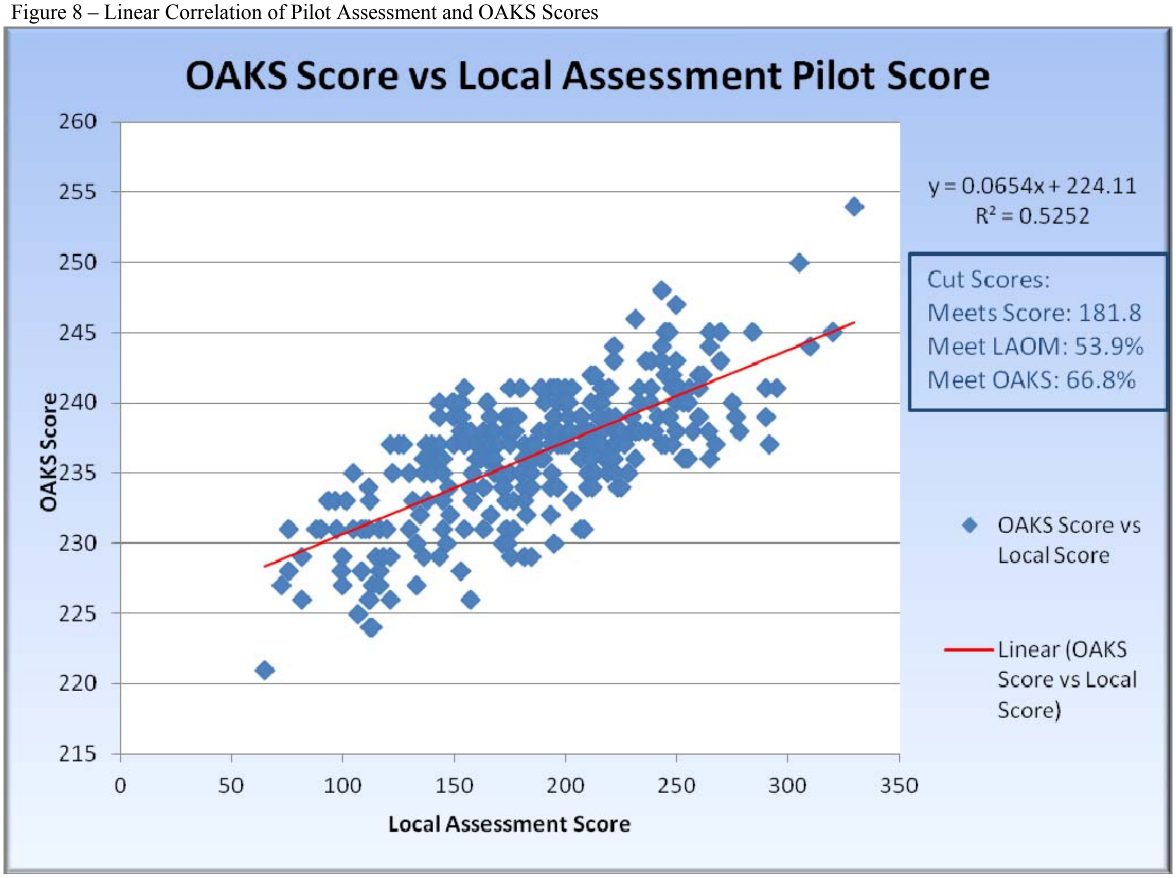
After these students were removed, there were 319 students left who were included in the data seen in this report.

Process for Setting Cut Score

Each student was given an identification number which connected the student to his or her best OAKS score and his or her pilot assessment score. Linear regression calculations were done to determine the coefficient of determination. In statistics, the coefficient of determination, denoted R^2, indicates how well data points fit a line or curve. R-square can take on any value between 0 and 1, with a value closer to 1 indicating that a greater proportion of variance is accounted for by the model.

Figure 8 shows an R-square value of 0.5252. This means the correlation accounts for over 50% of the variation. A linear regression equation of $y = 0.0654x + 224.11$ represents the relationship between x, the students pilot assessment score, and y, their previous best OAKS score.

Figure 8 – Linear Correlation of Pilot Assessment and OAKS Scores



Using this linear regression model, a cut score can be determined by using the OAKS cut score of 236 for y in the equation, $y = 0.0654x + 224.11$. A cut score of 181.8 (rounded to 182) is determined.

$$\begin{aligned} 236 &= 0.0654x + 224.11 \\ -224.11 &\qquad\quad -224.11 \\ \frac{11.89}{0.0654} &= \frac{0.0654x}{0.0654} \\ 182 &\approx x \end{aligned}$$

Using a cut score of 182 on this assessment, 53.9% of the students would have passed the pilot assessment while 66.8% of the students actually passed the OAKS assessment. This differences shows that the assessment provides rigor at or above the OAKS assessment for scoring purposes. See Appendix D for the raw data that was used.

Figure 9 – Local Assessment Cut Score

Category	**OAKS Assessment Cut Scores**	**SMc Curriculum Local Assessment Cut Scores**
Meets	236	182

Discriminative Efficiency

Each question item involved in the pilot was examined for discriminative efficiency. This statistical analysis works under the assumption that students who have scored highly on the other parts of the test should also have scored highly on each individual question (or vice versa), so the score for an individual question and the score for the test as a whole should be well correlated. See Appendix E for a description of how discriminative efficiency is calculated.

The data of the pilot students was examined based on the current class students were enrolled in to better understand the discriminative efficiency values. For example, if students were enrolled in Algebra and had not yet taken Geometry, one could assume that the discriminative efficiency scores were useful in the Algebra domain but not as useful in the Geometry domain.

Items that had little or no discriminative efficiency have been edited for better clarity or removed from the assessment. This statistic will continue to be examined to continue to better the assessment.

Summary

The Local Assessment Option, created and tested by McMinnville School District, Pendleton School District and SMc Curriculum, was successfully piloted in Spring 2013. Based on the results of the pilot, the cut score for Essential Skills for this assessment is set at 182 points. This Local Assessment Option will continue to be refined and adjusted as students are held accountable to the Common Core State Standards.

Appendix A

Essential Skills Assessment Options
Per ODE Website July 2013

The following table summarizes the approved assessment options for the Essential Skill of Mathematics available as of October 30, 2009 for the graduating class of 2014. Please note that while the State Board of Education may either raise or lower the achievement standards for future graduating classes, the achievement standards included in the table below are the established standards which will apply to the graduating class of 2014.

ASSESSMENT OPTIONS (Only One Assessment Is Required)	ACHIEVEMENT STANDARD
OAKS Mathematics	**236**
ACT	**19**
PLAN	**19**
Work Keys	**5**
Compass	**66** **(Intermediate Algebra Test)**
ASSET	**41** **(Intermediate Algebra Test)**
SAT	**450**
PSAT	**45**
Advanced Placement (AP) tests: • AP Statistics • AP Calculus AB • AP Calculus BC	**3**
International Baccalaureate (IB) tests: • IB Mathematics SL • IB Mathematics HL • IB Math Studies	**4**
2 Mathematics Work Samples (one each for two of the following: geometry, algebraic relationships, statistics/probability)	**Score: 4 or higher in all five Process Dimensions.** (Work samples are locally scored with the Official State Mathematics Problem Solving Scoring Guide)

Appendix B

Standards Assessed on the SMc Curriculum Local Assessment Option

ALGEBRA TESTABLE TOPICS (50% OF ASSESSMENT)

OREGON 2009 TESTABLE TOPICS	COMMON CORE 2010 ASSESSABLE STANDARDS ITEMS
H.1A.1 Compare, order, and locate real numbers on a number line.	CC.8.NS.2 Use rational approximations of irrational numbers to compare the size of irrational numbers, locate them approximately on a number line diagram, and estimate the value of expressions (e.g., π^2).
H.1A.2 Evaluate, compute with, and determine equivalent numeric and algebraic expressions with real numbers and variables that may also include absolute value, integer exponents, square roots, pi, and/or scientific notation.	CC.8.EE.1 Know and apply the properties of integer exponents to generate equivalent numerical expressions. CC.8.EE.2 Use square root and cube root symbols to represent solutions to equations of the form x^2 = p and x^3 = p, where p is a positive rational number. Evaluate square roots of small perfect squares and cube roots of small perfect cubes. Know that √2 is irrational CC.8.EE.4 Perform operations with numbers expressed in scientific notation, including problems where both decimal and scientific notation are used. Use scientific notation and choose units of appropriate size for measurements of very large or very small quantities (e.g., use millimeters per year for seafloor spreading). Interpret scientific notation that has been generated by technology. CC.9-12.A.SSE.3 Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.
H.1A.3 Express square roots in equivalent radical form and their decimal approximations when appropriate.	CC.9-12.N.RN.2 Rewrite expressions involving radicals and rational exponents using the properties of exponents. CC.8.NS.2 Use rational approximations of irrational numbers to compare the size of irrational numbers, locate them approximately on a number line diagram, and estimate the value of expressions (e.g., π^2).
H.1A.4 Develop, identify, and/or justify equivalent algebraic expressions, equations, and inequalities using the properties of exponents, equality and inequality, as well as the commutative, associative, inverse, identity, and distributive properties.	CC.9-12.N.RN.2 Rewrite expressions involving radicals and rational exponents using the properties of exponents. CC.9-12.A.CED.1 Create equations and inequalities in one variable and use them to solve problems.
H.1A.5 Factor quadratic expressions limited to factoring common monomial terms, perfect-square trinomials, differences of squares, and quadratics of the form $x^2 + bx + c$ that factor over the integers.	CC.9-12.A.REI.4b Solve quadratic equations by inspection (e.g., for x^2 = 49), taking square roots, completing the square, the quadratic formula and factoring, as appropriate to the initial form of the equation. Recognize when the quadratic formula gives complex solutions and write them as a ± bi for real numbers a and b.
H.2A.1 Identify, construct, extend, and analyze linear patterns and functional relationships that are expressed contextually, numerically, algebraically, graphically, in tables, or using geometric figures.	CC.8.F.4 Construct a function to model a linear relationship between two quantities. Determine the rate of change and initial value of the function from a description of a relationship or from two (x, y) values, including reading these from a table or from a graph. Interpret the rate of change and initial value of a linear function in terms of the situation it models, and in terms of its graph or a table of values. CC.8.F.2 Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions).
H.2A.2 Given a rule, a context, two points, a table of values, a graph, or a linear equation in either slope intercept or standard form, identify the slope, determine the *x* and/or *y* intercept(s), and interpret the meaning of each.	CC.8.F.4 Construct a function to model a linear relationship between two quantities. Determine the rate of change and initial value of the function from a description of a relationship or from two (x, y) values, including reading these from a table or from a graph. Interpret the rate of change and initial value of a linear function in terms of the situation it models, and in terms of its graph or a table of values.
H.2A.3 Determine the equation of a line given any of the following information: two points on the line, its slope and one point on the line, or its graph. Also, determine an equation of a new line parallel or perpendicular to a given line, through a given point.	CC.9-12.A.CED.2 Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales. CC.9-12.G.GPE.5 Prove the slope criteria for parallel and perpendicular lines and use them to solve geometric problems (e.g., find the equation of a line parallel or perpendicular to a given line that passes through a given point).

H.2A.4 Fluently convert among representations of linear relationships given in the form of a graph of a line, a table of values, or an equation of a line in slope-intercept and standard form.	CC.9-12.F.IF.8 Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function.
H.2A.5 Given a linear function, interpret and analyze the relationship between the independent and dependent variables. Solve for *x* given f(*x*) or solve for f(*x*) given *x*.	CC.9-12.F.IF.2 Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context.
H.2A.6 Analyze how changing the parameters transforms the graph of $f(x) = mx + b$.	CC.9-12.F.LE.5 Interpret the parameters in a linear or exponential function in terms of a context.
H.2A.7 Write, use, and solve linear equations and inequalities using graphical and symbolic methods with one or two variables. Represent solutions on a coordinate graph or number line.	CC.9-12.A.REI.10 Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane, often forming a curve (which could be a line). CC.9-12.A.REI.12 Graph the solutions to a linear inequality in two variables as a halfplane (excluding the boundary in the case of a strict inequality), and graph the solution set to a system of linear inequalities in two variables as the intersection of the corresponding halfplanes. CC.9-12.A.CED.1 Create equations and inequalities in one variable and use them to solve problems.
H.2A.8 Solve systems of two linear equations graphically and algebraically, and solve systems of two linear inequalities graphically.	CC.8.EE.8b Solve systems of two linear equations in two variables algebraically, and estimate solutions by graphing the equations. Solve simple cases by inspection. CC.9-12.A.REI.12 Graph the solutions to a linear inequality in two variables as a halfplane (excluding the boundary in the case of a strict inequality), and graph the solution set to a system of linear inequalities in two variables as the intersection of the corresponding halfplanes
H.3A.1 Given a quadratic or exponential function, identify or determine a corresponding table or graph.	CC.9-12.F.IF.7 Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases. CC.9-12.A.CED.1 Create equations and inequalities in one variable and use them to solve problems. CC.9-12.F.LE.2 Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table).
H.3A.2 Given a table or graph that represents a quadratic or exponential function, extend the pattern to make predictions.	CC.9-12.A.CED.1 Create equations and inequalities in one variable and use them to solve problems.
H.3A.3Compare the characteristics of and distinguish among linear, quadratic, and exponential functions that are expressed in a table of values, a sequence, a context, algebraically, and/or graphically, and interpret the domain and range of each as it applies to a given context.	CC.9-12.F.LE.5 Interpret the parameters in a linear or exponential function in terms of a context.
H.3A.4 Given a quadratic or exponential function, interpret and analyze the relationship between the independent and dependent variables, and evaluate the function for specific values of the domain.	CC.9-12.F.IF.1 Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If f is a function and x is an element of its domain, then f(x) denotes the output of f corresponding to the input x. The graph of f is the graph of the equation y = f(x). CC.9-12.F.LE.1 Distinguish between situations that can be modeled with linear functions and with exponential functions. CC.9-12.F.LE.3 Observe using graphs and tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratically, or (more generally) as a polynomial function. CC.9-12.F.IF.1 Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If f is a function and x is an element of its domain, then f(x) denotes the output of f corresponding to the input x. The graph of f is the graph of the equation y = f(x). CC.9-12.F.IF.2 Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context.

H.3A.5 Given a quadratic function of the form $f(x) = x^2 + bx + c$ (or equation of the form $y = x^2 + bx + c$) with integer roots, determine and interpret the roots, the vertex of the parabola, and the equation for the axis of symmetry of the parabola graphically and algebraically.	CC.9-12.A.SSE.3a Factor a quadratic expression to reveal the zeros of the function it defines. CC.9-12.F.IF.8a Use the process of factoring and completing the square in a quadratic function to show zeros, extreme values, and symmetry of the graph, and interpret these in terms of a context. CC.9-12.A.REI.4a Use the method of completing the square to transform any quadratic equation in x into an equation of the form (x – p)^2 = q that has the same solutions. Derive the quadratic formula from this form. CC.9-12.A.REI.4b Solve quadratic equations by inspection (e.g., for x^2 = 49), taking square roots, completing the square, the quadratic formula and factoring, as appropriate to the initial form of the equation. Recognize when the quadratic formula gives complex solutions and write them as a ± bi for real numbers a and b.

GEOMETRY TESTABLE TOPICS (30% OF ASSESSMENT)

OREGON 2009 TESTABLE TOPICS	COMMON CORE 2010 ASSESSABLE STANDARDS ITEMS
H.1G.1 Identify, apply, and analyze angle relationships among two or more lines and a transversal to determine if lines are parallel, perpendicular, or neither.	CC.9-12.G.CO.9 Prove theorems about lines and angles. CC.8.G.5 Use informal arguments to establish facts about the angle sum and exterior angle of triangles, about the angles created when parallel lines are cut by a transversal, and the angle-angle criterion for similarity of triangles.
H.1G.2 Apply theorems, properties, and definitions to determine, identify, and justify congruency or similarity of triangles and to classify quadrilaterals.	CC.9-12.G.CO.6 Use geometric descriptions of rigid motions to transform figures and to predict the effect of a given rigid motion on a given figure; given two figures, use the definition of congruence in terms of rigid motions to decide if they are congruent. CC.9-12.G.CO.8 Explain how the criteria for triangle congruence (ASA, SAS, and SSS) follow from the definition of congruence in terms of rigid motions. CC.9-12.G.SRT.5 Use congruence and similarity criteria for triangles to solve problems and to prove relationships in geometric figures. CC.9-12.G.SRT.2 Given two figures, use the definition of similarity in terms of similarity transformations to decide if they are similar; explain using similarity transformations the meaning of similarity for triangles as the equality of all corresponding pairs of angles and the proportionality of all corresponding pairs of sides. CC.9-12.G.SRT.4 Prove theorems about triangles.
H.1G.3 Apply theorems of corresponding parts of congruent and similar figures to determine missing sides and angles of polygons.	CC.9-12.G.CO.7 Use the definition of congruence in terms of rigid motions to show that two triangles are congruent if and only if corresponding pairs of sides and corresponding pairs of angles are congruent. CC.9-12.G.SRT.2 Given two figures, use the definition of similarity in terms of similarity transformations to decide if they are similar; explain using similarity transformations the meaning of similarity for triangles as the equality of all corresponding pairs of angles and the proportionality of all corresponding pairs of sides. CC.8.G.1 Verify experimentally the properties of rotations, reflections, and translations: -- a. Lines are taken to lines, and line segments to line segments of the same length. -- b. Angles are taken to angles of the same measure. -- c. Parallel lines are taken to parallel lines. CC.9-12.G.SRT.5 Use congruence and similarity criteria for triangles to solve problems and to prove relationships in geometric figures.
H.1G.4 Use trigonometric ratios (sine, cosine and tangent) and the Pythagorean Theorem to solve for unknown lengths in right triangles.	CC.9-12.G.SRT.8 . Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems.

H.1G.5 Determine the missing dimensions, angles, or area of regular polygons, quadrilaterals, triangles, circles, composite shapes, and shaded regions.	CC.7.G.6 Solve real-world and mathematical problems involving area, volume and surface area of two- and three dimensional objects composed of triangles, quadrilaterals, polygons, cubes, and right prisms.
H.1G.6 Determine if three given lengths form a triangle. If the given lengths form a triangle, classify it as acute, right, or obtuse.	CC.7.G.2 Draw (freehand, with ruler and protractor, and with technology) geometric shapes with given conditions. Focus on constructing triangles from three measures of angles or sides, noticing when the conditions determine a unique triangle, more than one triangle, or no triangle.
H.1G.7 In problems involving circles, apply theorems and properties of chords, tangents, and angles; and theorems and formulas of arcs and sectors.	CC.9-12.G.C.2 Identify and describe relationships among inscribed angles, radii, and chords. CC.9-12.G.C.5 Derive using similarity the fact that the length of the arc intercepted by an angle is proportional to the radius, and define the radian measure of the angle as the constant of proportionality; derive the formula for the area of a sector.
H.2G.1 Identify, classify, model, sketch, and label representations of three-dimensional objects from nets and from different perspectives.	CC.6.G.4 Represent three-dimensional figures using nets made up of rectangles and triangles, and use the nets to find the surface area of these figures. Apply these techniques in the context of solving real-world and mathematical problems.
H.2G.2 Identify and apply formulas for surface area and volume of spheres; right solids, including rectangular prisms and pyramids; cones; and cylinders; and compositions thereof. Solve related context-based problems.	CC.9-12.G.GMD.3 Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems.
H.2G.3 Identify and apply formulas to solve for the missing dimensions of spheres and right solids, including rectangular prisms and pyramids, cones, and cylinders, both numerically and symbolically.	CC.9-12.G.GMD.3 Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems.
H.3G.2 Identify and perform single and composite transformations of geometric figures in a plane, including translations, origin-centered dilations, reflections across either axis or $y = \pm x$, and rotations about the origin in multiples of 90°.	CC.9-12.G.CO.3 Given a rectangle, parallelogram, trapezoid, or regular polygon, describe the rotations and reflections that carry it onto itself. CC.9-12.G.CO.5 Given a geometric figure and a rotation, reflection, or translation, draw the transformed figure using, e.g., graph paper, tracing paper, or geometry software. Specify a sequence of transformations that will carry a given figure onto another. CC.9-12.G.CO.2 . Represent transformations in the plane using, e.g., transparencies and geometry software; describe transformations as functions that take points in the plane as inputs and give other points as outputs. Compare transformations that preserve distance and angle to those that do not (e.g., translation versus horizontal stretch).
H.3G.3 Apply a scale factor to determine similar two- and three-dimensional figures, are similar. Compare and compute their respective areas and volumes of similar figures.	CC.9-12.G.SRT.1 Verify experimentally the properties of dilations given by a center and a scale factor: -- a. A dilation takes a line not passing through the center of the dilation to a parallel line, and leaves a line passing through the center unchanged. -- b. The dilation of a line segment is longer or shorter in the ratio given by the scale factor. CC.9-12.G.SRT.2 Given two figures, use the definition of similarity in terms of similarity transformations to decide if they are similar; explain using similarity transformations the meaning of similarity for triangles as the equality of all corresponding pairs of angles and the proportionality of all corresponding pairs of sides.
H.3G.4 Apply slope, distance, and midpoint formulas to solve problems in a coordinate plane.	CC.9-12.G.GPE.7 Use coordinates to compute perimeters of polygons and areas of triangles and rectangles, e.g., using the distance formula. CC.9-12.G.GPE.5 Prove the slope criteria for parallel and perpendicular lines and use them to solve geometric problems (e.g., find the equation of a line parallel or perpendicular to a given line that passes through a given point).

STATISTICS & PROBABILITY TESTABLE TOPICS (20% OF ASSESSMENT)

OREGON 2009 TESTABLE TOPICS	COMMON CORE 2010 ASSESSABLE STANDARDS ITEMS
H.1S.1 Given a context, determine appropriate survey methods, analyze the strengths and limitations of a particular survey, observational study, experiment, or simulation, and the display of its data.	CC.9-12.S.IC.3 Recognize the purposes of and differences among sample surveys, experiments, and observational studies; explain how randomization relates to each. CC.9-12.S.IC.2 . Decide if a specified model is consistent with results from a given data-generating process, e.g., using simulation.
H.1S.2 Evaluate data-based reports by considering the source of the data, the design of the study, and the way the data was analyzed and displayed.	CC.9-12.S.IC.6 Evaluate reports based on data. CC.7.SP.1 Understand that statistics can be used to gain information about a population by examining a sample of the population; generalizations about a population from a sample are valid only if the sample is representative of that population. Understand that random sampling tends to produce representative samples and support valid inferences.
H.1S.3 Compare and draw conclusions about two or more data sets using graphical displays or central tendencies and range.	CC.9-12.S.ID.2 Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (inter-quartile range, standard deviation) of two or more different data sets.
H.1S.4 Use or construct a scatter plot for a given data set, determine whether there is a(n) linear, quadratic, exponential, or no trend. If linear, determine if there is a positive or negative correlation among the data; and, if appropriate, sketch a line of best fit, and use it to make predictions.	CC.9-12.S.ID.6a Fit a function to the data; use functions fitted to data to solve problems in the context of the data. CC.9-12.S.ID.8 Compute (using technology) and interpret the correlation coefficient of a linear fit.
H.1S.5 Construct, analyze, and interpret tables, scatter plots, frequency distributions, and histograms of data sets.	CC.9-12.S.ID.1 Represent data with plots on the real number line (dot plots, histograms, and box plots). CC.9-12.S.ID.6 Represent data on two quantitative variables on a scatter plot, and describe how the variables are related.
H.2S.1 Identify, analyze, and use experimental and theoretical probability to estimate and calculate the probability of simple events.	CC.7.SP.7 Develop a probability model and use it to find probabilities of events. Compare probabilities from a model to observed frequencies; if the agreement is not good, explain possible sources of the discrepancy.
H.2S.2 Determine the sample space of a probability experiment.	CC.7.SP.8b Represent sample spaces for compound events using methods such as organized lists, tables and tree diagrams. For an event described in everyday language (e.g., "rolling double sixes"), identify the outcomes in the sample space which compose the event.
H.2S.3 Compute and interpret probabilities for independent, dependent, complementary, and compound events using various methods (e.g., diagrams, tables, area models, and counting techniques).	CC.9-12.S.CP.1 Describe events as subsets of a sample space (the set of outcomes) using characteristics (or categories) of the outcomes, or as unions, intersections, or complements of other events ("or," "and," "not"). CC.9-12.S.CP.2 Understand that two events A and B are independent if the probability of A and B occurring together is the product of their probabilities, and use this characterization to determine if they are independent. CC.9-12.S.CP.3 Understand the conditional probability of A given B as P(A and B)/P(B), and interpret independence of A and B as saying that the conditional probability of A given B is the same as the probability of A, and the conditional probability of B given A is the same as the probability of B.

Appendix C

Standards Assessed on Local Assessment by Graduating Class

Year	Standards Assessed	Standards Piloted
Class of 2014	Overlap of 2009 Oregon Standards and 2010 Common Core State Standards	Additional constructed response items for standards already assessed
Class of 2015	Overlap of 2009 Oregon Standards and 2010 Common Core State Standards	Non-Overlap Priority Clusters in the 2010 CCSS
Class of 2016	Overlap of 2009 Oregon Standards and 2010 Common Core State Standards plus additional CCSS Priority Clusters not in the overlap	Any additional CCSS non-Priority Cluster standards that are not + standards
Class of 2017 and beyond	All assessable Common Core State Standards (not including + standards)	Additional items as needed

Appendix D - Raw Data

Random ID	OAKS Composite Score	Projected OAKS Score	OAKS Test Score Value	Proj. Score - OAKS Score (Δy)	Local Assessment Grade/400.00
2119813	221	228.36	221	7.36	65
2103377	224	231.47	224	7.47	112.5
2107199	224	231.52	224	7.52	113.33
1441646	225	231.09	225	6.09	106.67
2115935	226	229.45	226	3.45	81.67
2107073	226	231.41	226	5.41	111.67
2121731	226	231.47	226	5.47	112.5
2113093	226	232.07	226	6.07	121.67
2115662	226	234.41	226	8.41	157.5
1693345	227	228.85	227	1.85	72.5
1168695	227	230.65	227	3.65	100
1455611	227	231.52	227	4.52	113.33
2108438	227	231.74	227	4.74	116.67
2119302	227	232.83	227	5.83	133.33
1563901	228	229.07	228	1.07	75.83
1441268	228	230.60	228	2.60	99.17
2120520	228	231.19	228	3.19	108.33
1431006	228	231.74	228	3.74	116.67
1290558	228	234.14	228	6.14	153.33
2120464	229	229.45	229	0.45	81.67
2121710	229	230.65	229	1.65	100
1457760	229	231.63	229	2.63	115
1422655	229	231.85	229	2.85	118.33
1529370	229	232.07	229	3.07	121.67
2123019	229	233.05	229	4.05	136.67
1379794	229	233.48	229	4.48	143.33
2112498	229	235.61	229	6.61	175.83
1431118	229	235.99	229	6.99	181.67
1422648	229	236.21	229	7.21	185
1462919	230	232.83	230	2.83	133.33
2119043	230	233.70	230	3.70	146.67
1445335	230	235.34	230	5.34	171.67
2103587	230	235.50	230	5.50	174.17
1422599	230	236.86	230	6.86	195
1152098	231	229.07	231	-1.93	75.83
1168751	231	229.89	231	-1.11	88.33
1830762	231	230.00	231	-1.00	90
1830762	231	230.00	231	-1.00	90
1636008	231	230.49	231	-0.51	97.5
1342421	231	230.49	231	-0.51	97.5
1830762	231	230.98	231	-0.02	105
2111126	231	231.19	231	0.19	108.33

Random ID	OAKS Composite Score	Projected OAKS Score	OAKS Test Score Value	Proj. Score - OAKS Score (Δy)	Local Assessment Grade/400.00
1364933	231	231.30	231	0.30	110
2118903	231	231.41	231	0.41	111.67
1352179	231	231.74	231	0.74	116.67
1372024	231	231.96	231	0.96	120
1422718	231	232.61	231	1.61	130
2117223	231	233.59	231	2.59	145
1430824	231	234.25	231	3.25	155
1286267	231	234.79	231	3.79	163.33
1420345	231	235.45	231	4.45	173.33
2116278	231	235.66	231	4.66	176.67
1402957	231	237.63	231	6.63	206.67
1430929	231	237.73	231	6.73	208.33
1366025	232	232.94	232	0.94	135
1430831	232	233.81	232	1.81	148.33
1429186	232	235.01	232	3.01	166.67
1128501	232	236.05	232	4.05	182.5
1441597	232	236.75	232	4.75	193.33
1365031	233	230.21	233	-2.79	93.33
1140303	233	230.43	233	-2.57	96.67
1365472	233	230.76	233	-2.24	101.67
1302353	233	231.47	233	-1.53	112.5
1267472	233	232.72	233	-0.28	131.67
1495343	233	233.16	233	0.16	138.33
2112092	233	233.59	233	0.59	145
1320476	233	234.46	233	1.46	158.33
1353481	233	234.46	233	1.46	158.33
2107318	233	235.45	233	2.45	173.33
2120086	233	235.66	233	2.66	176.67
1178838	233	235.99	233	2.99	181.67
1455296	233	237.41	233	4.41	203.33
1375643	234	231.41	234	-2.59	111.67
1352249	234	233.76	234	-0.24	147.5
1451544	234	234.41	234	0.41	157.5
1375426	234	234.79	234	0.79	163.33
2111434	234	235.34	234	1.34	171.67
1169927	234	235.39	234	1.39	172.5
2103335	234	235.99	234	1.99	181.67
1263125	234	236.21	234	2.21	185
1422697	234	236.75	234	2.75	193.33
1479453	234	236.97	234	2.97	196.67
2101711	234	237.84	234	3.84	210
1268067	234	238.01	234	4.01	212.5
1422711	234	238.72	234	4.72	223.33

Random ID	OAKS Composite Score	Projected OAKS Score	OAKS Test Score Value	Proj. Score - OAKS Score (Δy)	Local Assessment Grade/400.00
1422193	234	238.83	234	4.83	225
1355504	235	230.98	235	-4.02	105
1570530	235	232.12	235	-2.88	122.5
1444971	235	232.61	235	-2.39	130
2104154	235	233.05	235	-1.95	136.67
2121626	235	233.27	235	-1.73	140
1366130	235	233.59	235	-1.41	145
2104301	235	234.46	235	-0.54	158.33
1356981	235	235.12	235	0.12	168.33
1290439	235	235.23	235	0.23	170
1748421	235	235.28	235	0.28	170.83
1420709	235	235.56	235	0.56	175
2108676	235	235.88	235	0.88	180
2122060	235	235.88	235	0.88	180
1424202	235	236.21	235	1.21	185
2120296	235	236.81	235	1.81	194.17
1801271	235	237.84	235	2.84	210
1429739	235	238.06	235	3.06	213.33
1356946	235	238.44	235	3.44	219.17
1873021	235	238.66	235	3.66	222.5
1441331	235	239.04	235	4.04	228.33
1286988	236	233.05	236	-2.95	136.67
1377624	236	233.16	236	-2.84	138.33
1152021	236	233.27	236	-2.73	140
2122032	236	233.43	236	-2.57	142.5
2116726	236	233.54	236	-2.46	144.17
1283138	236	233.59	236	-2.41	145
1549565	236	234.57	236	-1.43	160
1686989	236	234.68	236	-1.32	161.67
2117314	236	234.74	236	-1.26	162.5
2111294	236	234.90	236	-1.10	165
1367313	236	234.90	236	-1.10	165
1278868	236	234.90	236	-1.10	165
1280464	236	235.01	236	-0.99	166.67
2120870	236	235.06	236	-0.94	167.5
1436641	236	235.12	236	-0.88	168.33
1758172	236	235.12	236	-0.88	168.33
1422781	236	235.99	236	-0.01	181.67
1838924	236	235.99	236	-0.01	181.67
2103349	236	235.99	236	-0.01	181.67
1422809	236	236.10	236	0.10	183.33
1671981	236	236.21	236	0.21	185
1398442	236	236.32	236	0.32	186.67

Random ID	OAKS Composite Score	Projected OAKS Score	OAKS Test Score Value	Proj. Score - OAKS Score (Δy)	Local Assessment Grade/400.00
1268305	236	236.48	236	0.48	189.17
1357191	236	236.54	236	0.54	190
2108123	236	237.63	236	1.63	206.67
1283236	236	237.95	236	1.95	211.67
1839652	236	238.33	236	2.33	217.5
1363946	236	238.39	236	2.39	218.33
1646977	236	238.50	236	2.50	220
2112204	236	238.61	236	2.61	221.67
1282214	236	239.26	236	3.26	231.67
1371177	236	240.68	236	4.68	253.33
1423537	236	240.73	236	4.73	254.17
2107311	236	240.79	236	4.79	255
1440463	236	241.44	236	5.44	265
1267913	237	232.07	237	-4.93	121.67
1353572	237	232.29	237	-4.71	125
1140940	237	232.45	237	-4.55	127.5
1154940	237	233.10	237	-3.90	137.5
1440729	237	233.27	237	-3.73	140
1455212	237	233.48	237	-3.52	143.33
2106989	237	233.92	237	-3.08	150
1266534	237	234.25	237	-2.75	155
1839596	237	234.57	237	-2.43	160
1365437	237	234.57	237	-2.43	160
1495273	237	234.79	237	-2.21	163.33
2119309	237	235.01	237	-1.99	166.67
1342015	237	235.23	237	-1.77	170
1352319	237	235.56	237	-1.44	175
1356778	237	235.99	237	-1.01	181.67
1460623	237	236.21	237	-0.79	185
2119435	237	236.32	237	-0.68	186.67
1569193	237	236.75	237	-0.25	193.33
1296193	237	236.97	237	-0.03	196.67
1376364	237	237.08	237	0.08	198.33
1269222	237	237.19	237	0.19	200
1679114	237	237.30	237	0.30	201.67
1352186	237	237.73	237	0.73	208.33
2107052	237	237.84	237	0.84	210
1420786	237	237.84	237	0.84	210
1403748	237	237.95	237	0.95	211.67
1419792	237	237.95	237	0.95	211.67
1297761	237	237.95	237	0.95	211.67
1466986	237	238.01	237	1.01	212.5
1426484	237	238.06	237	1.06	213.33

Random ID	OAKS Composite Score	Projected OAKS Score	OAKS Test Score Value	Proj. Score - OAKS Score (Δy)	Local Assessment Grade/400.00
1341511	237	238.06	237	1.06	213.33
1365850	237	238.17	237	1.17	215
1442878	237	238.28	237	1.28	216.67
1301555	237	238.61	237	1.61	221.67
1331445	237	238.72	237	1.72	223.33
1863081	237	238.93	237	1.93	226.67
2115788	237	240.02	237	3.02	243.33
1527907	237	240.13	237	3.13	245
1422613	237	240.35	237	3.35	248.33
1352123	237	241.60	237	4.60	267.5
2120506	237	243.19	237	6.19	291.67
1462142	238	234.14	238	-3.86	153.33
1352193	238	234.30	238	-3.70	155.83
1371051	238	234.41	238	-3.59	157.5
1640502	238	234.79	238	-3.21	163.33
1848206	238	235.01	238	-2.99	166.67
1297404	238	235.12	238	-2.88	168.33
2106996	238	235.45	238	-2.55	173.33
1353579	238	235.56	238	-2.44	175
2115641	238	235.61	238	-2.39	175.83
1268039	238	235.72	238	-2.28	177.5
1356722	238	236.43	238	-1.57	188.33
1353558	238	236.65	238	-1.35	191.67
1371506	238	236.86	238	-1.14	195
2107031	238	236.97	238	-1.03	196.67
1262957	238	236.97	238	-1.03	196.67
1264133	238	237.24	238	-0.76	200.83
1426274	238	237.30	238	-0.70	201.67
1356932	238	237.35	238	-0.65	202.5
1534417	238	237.63	238	-0.37	206.67
1365416	238	237.63	238	-0.37	206.67
2113205	238	237.68	238	-0.32	207.5
2101886	238	237.84	238	-0.16	210
1283348	238	237.95	238	-0.05	211.67
2102292	238	238.28	238	0.28	216.67
2101816	238	238.28	238	0.28	216.67
1450557	238	238.28	238	0.28	216.67
1426547	238	238.66	238	0.66	222.5
1282907	238	238.72	238	0.72	223.33
1357177	238	238.72	238	0.72	223.33
2103790	238	238.83	238	0.83	225
2115088	238	239.15	238	1.15	230
1428794	238	239.26	238	1.26	231.67

Random ID	OAKS Composite Score	Projected OAKS Score	OAKS Test Score Value	Proj. Score - OAKS Score (Δy)	Local Assessment Grade/400.00
1317627	238	239.26	238	1.26	231.67
2116110	238	239.37	238	1.37	233.33
1282410	238	239.59	238	1.59	236.67
1283243	238	239.81	238	1.81	240
1266821	238	240.46	238	2.46	250
1495539	238	240.46	238	2.46	250
1455338	238	240.95	238	2.95	257.5
2115361	238	241.39	238	3.39	264.17
1352326	238	242.31	238	4.31	278.33
1352263	239	233.48	239	-5.52	143.33
1637611	239	233.92	239	-5.08	150
1356834	239	234.14	239	-4.86	153.33
2108095	239	235.01	239	-3.99	166.67
2117307	239	235.45	239	-3.55	173.33
1140646	239	235.56	239	-3.44	175
1701682	239	235.66	239	-3.34	176.67
1266835	239	235.72	239	-3.28	177.5
1169619	239	235.77	239	-3.23	178.33
1426162	239	236.86	239	-2.14	195
1355385	239	236.86	239	-2.14	195
1422767	239	237.30	239	-1.70	201.67
1169619	239	237.63	239	-1.37	206.67
1371142	239	237.68	239	-1.32	207.5
1430985	239	238.17	239	-0.83	215
1368167	239	238.50	239	-0.50	220
1269229	239	238.66	239	-0.34	222.5
2108382	239	239.15	239	0.15	230
1426246	239	239.92	239	0.92	241.67
1340881	239	240.24	239	1.24	246.67
1527354	239	240.24	239	1.24	246.67
1364765	239	241.11	239	2.11	260
1282851	239	242.20	239	3.20	276.67
2120541	239	243.08	239	4.08	290
1356750	240	233.48	240	-6.52	143.33
1279260	240	233.87	240	-6.13	149.17
2111525	240	233.92	240	-6.08	150
1385331	240	234.14	240	-5.86	153.33
1264147	240	234.14	240	-5.86	153.33
1353446	240	234.90	240	-5.10	165
1287604	240	236.59	240	-3.41	190.83
1375419	240	236.97	240	-3.03	196.67
1431181	240	237.14	240	-2.86	199.17
1422536	240	237.19	240	-2.81	200

Random ID	OAKS Composite Score	Projected OAKS Score	OAKS Test Score Value	Proj. Score - OAKS Score (Δy)	Local Assessment Grade/400.00
1353544	240	237.30	240	-2.70	201.67
1726434	240	237.95	240	-2.05	211.67
2116551	240	238.17	240	-1.83	215
1431195	240	238.28	240	-1.72	216.67
1422760	240	239.37	240	-0.63	233.33
1533150	240	239.70	240	-0.30	238.33
2107766	240	240.46	240	0.46	250
1410055	240	240.68	240	0.68	253.33
1365976	240	240.79	240	0.79	255
1365073	240	240.79	240	0.79	255
1291020	240	242.10	240	2.10	275
1355889	241	234.25	241	-6.75	155
1421591	241	235.56	241	-5.44	175
2110797	241	235.88	241	-5.12	180
1401333	241	236.48	241	-4.52	189.17
1274689	241	236.75	241	-4.25	193.33
1403755	241	236.86	241	-4.14	195
1269257	241	236.97	241	-4.03	196.67
1368265	241	237.19	241	-3.81	200
1422473	241	237.19	241	-3.81	200
1453210	241	237.41	241	-3.59	203.33
1169577	241	238.28	241	-2.72	216.67
1431111	241	238.50	241	-2.50	220
1365234	241	238.50	241	-2.50	220
1431244	241	239.37	241	-1.63	233.33
1422501	241	239.70	241	-1.30	238.33
1364870	241	240.35	241	-0.65	248.33
2111252	241	240.46	241	-0.54	250
1684609	241	240.57	241	-0.43	251.67
1355518	241	240.84	241	-0.16	255.83
1357219	241	241.11	241	0.11	260
1291013	241	243.08	241	2.08	290
2111455	241	243.40	241	2.40	295
1318607	242	237.95	242	-4.05	211.67
1371317	242	238.06	242	-3.94	213.33
1366816	242	240.13	242	-1.87	245
1537721	242	240.35	242	-1.65	248.33
1771801	242	241.11	242	-0.89	260
1450417	242	241.22	242	-0.78	261.67
1268025	242	241.22	242	-0.78	261.67
1671477	243	238.61	243	-4.39	221.67
2120940	243	239.59	243	-3.41	236.67
1352277	243	239.70	243	-3.30	238.33

Random ID	OAKS Composite Score	Projected OAKS Score	OAKS Test Score Value	Proj. Score - OAKS Score (Δy)	Local Assessment Grade/400.00
1422445	243	240.02	243	-2.98	243.33
1771024	243	240.46	243	-2.54	250
1431258	243	241.77	243	-1.23	270
1357156	244	238.61	244	-5.39	221.67
1566022	244	240.02	244	-3.98	243.33
1422634	244	241.44	244	-2.56	265
1421528	244	244.38	244	0.38	310
1411861	245	240.13	245	-4.87	245
1431020	245	240.24	245	-4.76	246.67
1422620	245	241.44	245	-3.56	265
1814382	245	241.77	245	-3.23	270
1748302	245	242.69	245	-2.31	284.17
1268256	245	245.04	245	0.04	320
1422522	245	245.04	245	0.04	320
1168604	246	239.26	246	-6.74	231.67
1357100	247	240.46	247	-6.54	250
2120079	248	240.02	248	-7.98	243.33
2115585	250	244.06	250	-5.94	305
2101844	254	245.69	254	-8.31	330

Appendix E

The assessment included random questions so not all students attempted the same set of questions. To account for this, the analysis below distinguishes between positions in the test, and test items.

Notation used in the calculations

Students, who have completed an attempt on the quiz , are defined by $s \in S$.

The test has a number of positions $p \in P$. The test is assembled from a number of items $i \in I$. Because of random questions, different students may have received different items in different positions, so $i(p, s)$ is the item student s received in position p.

Let I_s be the set of items that student s saw. Let S_i be the set of students who attempted item i.

Each position has a maximum and minimum possible contribution to the test score, $x_p(min)$ and $x_p(max)$. At the moment in Moodle, $x_p(min)$ is always zero, but we cannot assume that will continue to be the case. $x_p(max)$ is database column quiz_question_instances.grade.

Then, each student achieved an actual score $x_p(s)$ on the item in position p. So $x_p(min) \le x_p(s) \le x_p(max)$.
$x_p(s)$ should be measured on the same scale as the final score for the quiz.

You can also think of the student's score on a particular item $x_i(s)$. However, in this case, the score should be measured out of the Default question grade for this question. Also, there is a $x_i(max)$ (= Default question grade) and $x_i(min)$ (currently, zero, but if we allow negative marking, that will change).
$x_{i(p, s)}(s) = x_p(s)\frac{x_i(max)}{x_p(max)}$.

Each student has a total score: $\displaystyle T_s = \sum_{p \in P} x_p(s)$.
Similarly, there are the maximum and minimum possible test scores
$\displaystyle T_{max} = \sum_{p \in P} x_p(max)$ and
$\displaystyle T_{min} = \sum_{p \in P} x_p(min)$

Discriminative efficiency

The idea is that for a sound question on a quiz (or at least a question that fits in with the other questions in the test), students who have scored highly on the other parts of the test should also have scored highly on each individual question, so the score for an individual question and the score for the test as a whole should be well correlated.

The discriminative efficiency value expresses $C(x_p, X_p)$ as a percentage of the maximum value it could have taken given the scores the students got on this question, and the test as a whole. That is, $\displaystyle DE_p = 100\frac{C(x_p, X_p)}{C_{max}(x_p, X_p)}$ where $C_{max}(x_p, X_p)$ is defined as follows: When you compute $C(x_p, X_p)$, you do the sum $\displaystyle C(x_p, X_p) = \frac{1}{S - 1} \sum_{s \in S} (x_p(s) - \bar{x}_p)(X_p(s) - \bar{X}_p)$ which involves a term for each student combining their question score and rest of test score.

You begin with an array of $x_p(s)$ with an array of corresponding $X_p(s)$, one for each s. To compute $C_{max}(x_p, X_p)$, you sort these two arrays before applying the above formula. That is, for the purpose of computing C_{max}, you use the first student who scored the lowest x_p and the lowest X_p, the second student who scored the second lowest x_p and the second lowest X_p, and so on to the last student, who scored the highest x_p and X_p.