2025

# XQ Math Badging System

## Student-Friendly Portfolio Indicators

## Table of Contents

# Student-Friendly Portfolio Indicators: M100

| | Indicator | *Notes* |
|---|---|---|
| | **Identifying Quantities** | |
| **100.a** | i. Choose important quantities for a situation. Then, use the relationship between the quantities to answer a question. | |
| | **Thinking About Units in Problems** | |
| **100.b** | i. Determine an appropriate scale on an axis for a graph or data display. | |
| | ii. Manipulate units in a problem. | |
| | iii. Explain how the units of a solution are related to the situation in a problem, formula, or data display. | |
| | **Interpreting Expressions** | |
| **100.c** | i. Select two different expressions that illustrate something important about the situation in a problem. Then, describe what these expressions tell you about the situation. | |
| | ii. Describe how a number or variable in an expression relates to the situation in a problem. | |
| | **Interpreting Proportional Relationships** | |
| **100.d** | i. Select two different *representations* that illustrate something important about a proportional relationship. Then, describe what these representations tell you about the situation.<br>*Equations, tables, or graphs* | |
| | ii. Choose a number, variable, or coordinate in an equation, table, or graph and describe what it tells you about the situation. | |
| | **Interpreting Data Displays** | |
| **100.e** | i. Select two different data displays that illustrate something | |

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| | important about a real-world situation. Then, describe what these displays tell you about the situation. | |
| | ii. Choose one aspect of a data display and describe what it tells you about the situation. | |
| **Solving Real-World Problems** | | |
| | **Indicator** | ***Notes*** |
| **100.f** | i. Write an expression with numbers or an expression with variables to model a situation. | |
| | ii. Use an expression to find the value for a variable. Then, explain what the value tells you about the situation in a problem. | |
| **Solving Real-World Problems About Area, Perimeter, Surface Area, and Volume** | | |
| **100.g** | i. Create an equation, table, or graph to represent a situation involving either area and perimeter of polygons or surface area and volume of prisms and pyramids. | |
| | ii. Use an equation, table, or graph to solve a problem. | |
| | iii. Explain what the solution tells you about the situation in a problem. | |
| **Solving Real-World Problems About Proportional Relationships** | | |
| **100.h** | i. Create an equation, table, or graph to model a proportional relationship. | |
| | ii. Use an equation, table, or graph to solve a real-world problem about a proportional relationship. | |
| | iii. Explain what the solution tells you about the situation in a problem. | |
| **Choosing Levels of Accuracy** | | |
| **100.i** | i. Explain a decision you made about how accurate your values needed to be in solving a problem. | |

# Student-Friendly Portfolio Indicators: M101

| | Indicator | *Notes* |
|---|---|---|
| **Reasoning About One-Variable Equations and Inequalities** | | |
| **101.a** | i. Use variables to represent numbers when you write equations or inequalities for real-world or mathematical problems. | |
| | ii. Show that a variable can represent an unknown number in an equation or inequality. | |
| | iii. Create examples of linear equations that have one solution, infinitely many solutions, and no solutions. | |
| **Solving Linear Expressions, Equations, and Inequalities** | | |
| **101.b** | i. Use *tools* to solve multi-step problems with rational numbers.<br><br>*Pencil and paper, models such as a table, ruler, graphing calculator, or graphing software* | |
| | ii. Create equations and inequalities to solve real-world or mathematical problems. | |
| **Solving Two-Variable Linear Equations** | | |
| **101.c** | i. Solve linear equations that have two variables. | |
| | ii. Solve a system of linear equations. | |
| **Graphing Linear Equations and Inequalities** | | |
| **101.d** | i. Explain why the x-coordinate of the point where two linear equations intersect is the solution to f(x) = g(x). | |
| | ii. Use a graph to find the solutions to a system of linear equations. | |

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| | iii. Graph a linear inequality in two variables clearly showing the boundary with solutions. Graph a system of linear inequalities in two variables clearly showing the intersection of solutions. | |

# Student-Friendly Portfolio Indicators: M102

| | Indicator | *Notes* |
|---|---|---|
| | **Engaging in the Modeling Cycle** | |
| **102.a** | i. Engage with the full modeling cycle—determine the problem, choose a strategy, find values, explain what the values mean, check that the values make sense, revise as necessary, share findings. | |
| | **Interpreting Linear Equations and Functions** | |
| **102.b** | i. Select two different data points that show something interesting or important about the situation in a problem. Then, describe what these points tell you about the situation. | |
| | ii. Use a *model* to find values. Then, explain what the values tell you about the situation in a problem.<br><br>*Table, equation, graph* | |
| | iii. Describe the domain of a linear function and the values that are not part of the domain. Provide a reason why those values are not part of the domain. | |
| | iv. State the rate of change for a linear *model*. Then, explain what it tells you about the situation.<br><br>*Table, equation, graph* | |
| | **Analyzing Linear Functions** | |
| **102.c** | i. Create a linear graph to represent a situation in a problem. Choose and describe values that help you understand something about the problem you are exploring. | |
| | ii. Explain how the key features of a linear model show up in its graph. | |

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| **Building Linear Functions** | | |
| **102.d** | i. Identify the quantities and variables in a situation or data set that show a linear relationship. | |
| | ii. Create a function that models the linear relationship between two quantities in a situation. | |
| | iii. Analyze the variables in your situation and indicate which variable is dependent | |
| **Solving Linear Equations in Two Variables** | | |
| | **Indicator** | ***Notes*** |
| **102.e** | i. Find the solution to a system of two linear equations. | |
| | ii. Explain whether a system of two linear equations will have one solution, no solution, or an infinite number of solutions. | |
| | iii. Create a system of two linear equations to model a real-world situation. | |
| | iv. Explain what the solution to a system of two linear equations tells you about a situation. | |
| **Interpreting Linear Expressions** | | |
| **102.f** | i. Describe what the slope and y-intercept of a linear function tell you about the situation. | |
| **Solving One-Variable Linear Equations and Inequalities** | | |
| **102.g** | i. Find the solution to a linear equation or inequality. | |
| | ii. Justify a solution to a linear equation or inequality by explaining how you found the solution. | |
| **Creating Linear Equations** | | |
| **102.h** | i. Identify the quantities and variables in a situation or data set that demonstrate a linear relationship. | |

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| | ii. Create an equation that models the linear relationship between two quantities in a situation. | |
| **Modeling with Linear Functions** | | |
| **102.i** | i. Share something that surprised you or something that you learned from modeling linear functions. | |
| | ii. Highlight something you are most proud of in your learning about modeling linear functions. | |
| | iii. Explain how modeling with linear functions can be used to answer important questions. | |
| **Using Linear Functions for Real-World Problems** | | |
| **102.j** | i. Use input values to determine one or more output values for the linear function. | |

# Student-Friendly Portfolio Indicators: M103

| | Indicator | *Notes* |
|---|---|---|
| | **Engaging in the Modeling Cycle** | |
| **103.a** | i. Engage with the full modeling cycle—determine the problem, choose a strategy, find values, explain what the values mean, check that the values make sense, revise as necessary, share findings. | |
| | **Interpreting Quadratic Functions** | |
| **103.b** | i. Select two different data points that show something important about the situation in a problem. Then, describe what these points tell you about the situation. | |
| | ii. Use a *model* to find values. Then, explain what the values tell you about the situation.<br><br>*Table, equation, graph* | |
| | iii. Describe the domain of the quadratic function and the values that are not part of the domain. Then, describe why the shape of the *model* might change for certain values of the domain.<br><br>*Table, equation, graph* | |
| | iv. State the average rate of change between two points for a quadratic function. Then, explain what the average rate of change tells you about the situation. | |
| | **Analyzing Quadratic Functions** | |
| **103.c** | i. Create a quadratic graph to represent a situation in a problem. Then, choose and describe important values that help you understand something about the problem you are exploring. | |
| | ii. Explain how the key features of a quadratic model show up in its | |

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| | graph. | |
| | **Building Quadratic Functions** | |
| **103.d** | i. Identify the quantities and variables in a given situation or data set that demonstrate a quadratic relationship. | |
| | ii. Create a function that models the quadratic relationship between two quantities in a situation. | |
| | **Indicator** | ***Notes*** |
| | **Constructing and Comparing Linear and Quadratic Models** | |
| **103.e** | i. Use the rate of change to determine situations that can be modeled with linear functions and situations that can be modeled with quadratic functions. | |
| | ii. Explain why some relationships are linear and others are quadratic. Explain why a quadratic function is a better model than a linear function for a situation in some cases. | |
| | **Interpreting Quadratic Functions** | |
| **103.f** | i. Describe what the key features for a quadratic function tell you about the situation. | |
| | **Analyzing Quantitative Data for Linear and Quadratic Models** | |
| **103.g** | i. Choose a particular representation of your data to communicate something important to an audience. Then, explain why you made that choice. | |
| | **Modeling With Quadratic Functions** | |
| **103.h** | i. Share something that surprised you or something that you learned from modeling quadratic functions. | |
| | ii. Highlight something you are most proud of in your learning about modeling quadratic functions. | |
| | iii. Explain how modeling can be used to answer important questions. | |

| Using Quadratic Functions in Real-World Problems | | |
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| **103.i** | i. Use input values to determine one or more output values for a quadratic function. | |

# Student-Friendly Portfolio Indicators: M104

| | Indicator | *Notes* |
|---|---|---|
| | **Engaging in the Modeling Cycle** | |
| **104.a** | i. Engage with the full modeling cycle—determine the problem, choose a strategy, find values, explain what the values mean, check that the values make sense, revise as necessary, share findings. | |
| | **Interpreting Exponential Functions** | |
| **104.b** | i. Select two different data points that show something important about the situation you are modeling. Then, describe what these points tell you about the situation. | |
| | ii. Use a *model* to find values. Then, explain what the values tell you about the situation.<br><br>*Table, equation, graph* | |
| | iii. Describe the domain of the exponential function and values that are not part of the domain. Then, describe why the shape of the *model* might change for certain values of the domain.<br><br>*Table, equation, graph* | |
| | iv. State the average rate of change between two points for an exponential function. Then, explain what the average rate of change tells you about the situation in a problem. | |
| | **Analyzing Exponential Functions** | |
| **104.c** | i. Create an exponential graph to show a certain situation and describe important values that help to understand something about the situation you are exploring. | |
| | ii. Explain how the key features of an exponential model show up in its | |

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| | graph. | |
| | **Building Exponential Functions** | |
| **104.d** | i. Identify the variables of interest in a given situation or data set that are interesting and that demonstrate an exponential relationship. | |
| | ii. Build a function that models the exponential relationship between two quantities. | |
| | **Indicator** | ***Notes*** |
| | **Constructing and Comparing Linear and Exponential Models** | |
| **104.e** | i. Distinguish between situations that can be modeled with linear functions and those that can be modeled with exponential functions. | |
| | ii. Provide insight into why some relationships are linear and others are exponential. Explain why an exponential function is a better model than a linear function in some cases. | |
| | **Interpreting Expressions for Exponential Functions** | |
| **104.f** | i. Describe what the y-intercept and rate of change for an exponential function tell you about the situation in a problem. | |
| | **Analyzing Quantitative Data for Linear and Exponential Models** | |
| **104.g** | i. Choose a particular representation of your data to communicate something important to an audience. Then, explain why you made that choice. | |
| | **Modeling With Exponential Functions** | |
| **104.h** | i. Share something that surprised you or something that you learned from modeling exponential functions. | |
| | ii. Highlight something you are most proud of in your learning about modeling exponential functions. | |
| | iii. Explain how modeling can be used to answer important questions. | |

| Using Exponential Functions in Real-World Problems | | |
|---|---|---|
| **104.i** | i. Use input values to determine one or more output values for the exponential function. | |

# Student-Friendly Portfolio Indicators: M111

| | Indicator | *Notes* |
|---|---|---|
| **Engaging in the Modeling Cycle** | | |
| **111.a** | i. Engage with the full modeling cycle—determine the problem, choose a strategy, find values, explain what the values mean, check that the values make sense, revise as necessary, share findings. | |
| **Creating Statistical Questions for One-Variable Data** | | |
| **111.b** | i. Create a statistical question to investigate. | |
| | ii. Explain or justify why your question is statistical. | |
| **Interpreting Features of One-Variable Data Sets** | | |
| **111.c** | i. Create an *appropriate representation* of collected data.<br><br>*Box plot, line plot, histogram, or other data display* | |
| | ii. Describe the shape, center, and spread of a data set. | |
| | iii. Explain the real-world meaning of the shape, center, and spread of a data set. | |
| | iv. Identify an outlier or outliers of a data set. Explain the effect of an outlier on the shape, center, and spread. | |
| **Describing One-Variable Data** | | |
| **111.d** | i. Find the mean or median of a set of data and explain its meaning. | |
| | ii. Find the interquartile range or standard deviation of a set of data and explain what it tells you about the data. | |
| **Generating Random Samples** | | |

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| **111.e** | i. Describe a process for creating a random sample to investigate a statistical question. | |
| | ii. Explain why the process is appropriate for the statistical question being investigated. | |
| **Comparing Different Data Sets** | | |
| | **Indicator** | ***Notes*** |
| **111.f** | i. Create a box plot, line plot, histogram, or other data display for two data sets that are related. | |
| | ii. Find *measures of center* and *variability* for two data sets.<br><br>*mean or median*<br>*standard deviation or interquartile range* | |
| | iii. Compare the center and variability of two data sets. | |
| | iv. Explain why you chose to use the mean or median to compare two populations. Explain why you chose to use standard deviation or interquartile range to compare two populations. | |
| **Estimating Population Percentages** | | |
| **111.g** | i. Explain why a normal distribution is an appropriate approximation for a data set. | |
| | ii. Find an estimated population percentage by using a normal curve to approximate a data distribution. | |
| | iii. Explain the meaning of an estimated population percentage. | |

# Student-Friendly Portfolio Indicators: M112

| | Indicator | *Notes* |
|---|---|---|
| **Engaging in the Modeling Cycle** | | |
| **112.a** | i. Engage with the full modeling cycle—determine the problem, choose a strategy, find values, explain what the values mean, check that the values make sense, revise as necessary, share findings. | |
| **Using Scatter Plots for Two-Variable Data Sets** | | |
| **112.b** | i. Construct a scatter plot from collected data by hand or using technology. | |
| | ii. Explain the meaning of a data point in a scatter plot. | |
| **Identifying Patterns in a Scatter Plot** | | |
| **112.c** | i. Identify the type of association in a scatter plot. | |
| | ii. Give a hypothesis that might explain the association identified in a scatter plot. | |
| **Scatter Plots With a Linear Association** | | |
| **112.d** | i. Sketch a line that follows a pattern of linear association. | |
| | ii. Justify the location and direction of a line drawn to fit data. | |
| **Fitting Two-Variable Data With a Function** | | |
| **112.e** | i. Graph a linear, quadratic, or exponential function that models two-variable data. | |
| | ii. Find the equation for a linear, quadratic, or exponential function that models two-variable data. | |
| | iii. Justify the choice of linear, quadratic, or exponential function to model two-variable data. | |

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| **Using Functions To Answer Questions** | | |
| **112.f** | i. Explain the meaning of different features for a function that is used to fit two-variable data. | |
| | ii. Use a function that is fit to two-variable data to predict values. | |
| | **Indicator** | ***Notes*** |
| | iii. Describe any limitations in a model that is being used to answer a question. | |
| **Using Tools To Assess the Fit of a Function** | | |
| **112.g** | i. Find the correlation coefficient for a function fitted to two-variable data. | |
| | ii. Explain what the correlation coefficient tells you about the situation. | |
| | iii. Plot residuals for a function fitted to two-variable data. | |
| | iv. Explain what a residual plot is in terms of a function's goodness of fit. | |
| **Analyzing Two-Variable Data** | | |
| **112.h** | i. Develop a proposal or recommendation grounded in your analysis. | |
| | ii. Explain a limitation of a curve fitted to data. | |
| | iii. Explain the difference between correlation and causation. | |

# Student-Friendly Portfolio Indicators: M113

| | Indicator | *Notes* |
|---|---|---|
| **Engaging in the Modeling Cycle** | | |
| **113.a** | i. Engage with the full modeling cycle—determine the problem, choose a strategy, find values, explain what the values mean, check that the values make sense, revise as necessary, share findings. | |
| **Statistical Experiments** | | |
| **113.b** | i. Use an experiment or simulation to generate frequencies for compound events. | |
| | ii. Decide if a model is consistent with results from a given simulation. | |
| | iii. Make an inference about a population based on a random sample. | |
| **Probability of Events** | | |
| **113.c** | i. Determine the probability of an event. | |
| | ii. Compare the probabilities of two different events. | |
| **Probabilities of Compound Events** | | |
| **113.d** | i. Determine the probability of the intersection or union of multiple events. | |
| **Independent Events and Conditional Probability** | | |
| **113.e** | i. Use “or,” “and,” and “not,” to describe events as subsets of a sample space. | |
| | ii. Explain or show why two events can be considered independent or dependent. | |
| | iii. Determine a conditional probability. | |
| **Using Probabilities To Make Decisions** | | |

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| **113.f** | i. Use probability to make a recommendation. | |

# Student-Friendly Portfolio Indicators: M151

| | Indicator | *Notes* |
|---|---|---|
| **Engaging in the Modeling Cycle** | | |
| **151.a** | i. Engage with the full modeling cycle—determine the problem, choose a strategy, find values, explain what the values mean, check that the values make sense, revise as necessary, share findings. | |
| **Using Geometric Shapes to Describe Objects** | | |
| **151.b** | i. Represent something from the world as a geometric shape. | |
| | ii. Explain how the geometric shape represents the real-life situation or object. | |
| | iii. Use properties of the geometric shape to determine quantities. Then, explain what those values tell you about the situation. | |
| **Density in Modeling Situations** | | |
| **151.c** | i. Show your understanding of density based on area. | |
| | ii. Show your understanding of density based on volume. | |
| **Solving Design Problems** | | |
| **151.d** | i. Design an object or structure for a real-life situation. | |
| **Formulas for Circumference, Area, and Volume** | | |
| **151.e** | i. Explain the basis for circumference, area, and volume formulas. | |
| **Volume Formulas** | | |

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| **151.f** | i. Solve real-life and mathematical problems using volume formulas for cylinders, pyramids, cones, and spheres. | |
| **Solving Real World Problems About Area, Volume, and Surface Area** | | |
| **151.g** | i. Analyze the details of a situation in a problem and identify which geometric features are important. | |
| | **Indicator** | ***Notes*** |
| | ii. Solve real-life problems using area, volume, and surface area of two- or three-dimensional objects composed of triangles, quadrilaterals, polygons, cubes, or right prisms. | |
| **Right Triangles and Pythagorean Theorem** | | |
| **151.h** | i. Recognize situations where the Pythagorean theorem is a useful tool for representing and solving problems. | |
| | ii. Solve problems using the Pythagorean theorem. | |

# Student-Friendly Portfolio Indicators: M152

| | Indicator | *Notes* |
|---|---|---|
| **Rotations, Reflections, and Translations** | | |
| **152.a** | i. Use *appropriate terms* to explain rotation, reflection, or translation.<br><br>*Angle, circle, perpendicular line, parallel line, or line segment* | |
| **Transforming Figures** | | |
| **152.b** | i. Use *tools* to create a rotated, reflected, or translated figure.<br><br>*Graph paper, tracing paper, or geometry software* | |
| | ii. Explain how you rotated, reflected, or translated a figure. | |
| **Sequence of Transformations** | | |
| **152.c** | i. Describe a sequence of transformations that would move a figure onto another figure. | |
| **Describing Transformations** | | |
| **152.d** | i. Describe how a set of transformations changes the original image. | |
| | ii. Describe how a set of transformations affects the points of an image. | |
| **Congruent Figures** | | |
| **152.e** | i. Write an argument for why two figures are congruent. | |
| | ii. Write an argument for why two figures are not congruent. | |
| **Congruent Triangles** | | |

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| **152.f** | i. Show an example illustrating that if two triangles are congruent, then corresponding angles and corresponding sides are also congruent. | |
| | ii. Explain in general why if two triangles are congruent, then corresponding angles and corresponding sides are also congruent. | |
| | iii. Show an example illustrating that if two triangles have corresponding angles and corresponding sides that are congruent, then the two triangles are also congruent. | |
| | iv. Explain in general why if two triangles have corresponding angles and corresponding sides that are congruent, then the two triangles are also congruent. | |
| **Triangle Congruence (ASA, SAS, and SSS)** | | |
| | **Indicator** | ***Notes*** |
| **152.g** | i. Show an example illustrating that if two triangles meet one of the *triangle congruence criteria*, then they are congruent.<br><br>*ASA, SAS, or SSS* | |
| | ii. Explain in general why if two triangles meet one of the *triangle congruence criteria*, then they are congruent.<br><br>*ASA, SAS, or SSS* | |
| **Proving Theorems About Lines and Angles** | | |
| **152.h** | i. Find an unknown length or angle measurement in a diagram containing lines and angles. Then, explain how you determined your answer. | |
| | ii. Read a proof of a statement about lines and angles and explain it in your own words. | |
| | iii. Write a proof of a statement about lines and angles, using rigid transformations or congruence in your reasoning. | |

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| **Proving Theorems About Triangles** | | |
| **152.i** | i. Find an unknown length or angle measurement in a triangle. Then, explain how you determined your answer. | |
| | ii. Read a proof of a statement about triangles and explain it in your own words. | |
| | iii. Write a proof of a statement about triangle using rigid transformations or congruence in your reasoning. | |
| **Proving Theorems About Parallelograms** | | |
| **152.j** | i. Find an unknown length or angle measurement in a parallelogram. Then, explain how you determined your answer. | |
| | ii. Read a proof of a statement about parallelograms and explain it in your own words. | |
| | iii. Write a proof of a statement about parallelograms, using rigid transformations or congruence in your reasoning. | |
| **Geometric Constructions** | | |
| **152.k** | i. Construct a geometric figure using *tools*, such as a compass or straightedge or dynamic software. | |
| | ii. Explain how you constructed a geometric figure. | |

# Student-Friendly Portfolio Indicators: M153

| | Indicator | *Notes* |
|---|---|---|
| **Dilating Figures** | | |
| **153.a** | i. Create a dilated figure using graph paper, tracing paper, or geometry software. | |
| | ii. Explain how you dilate a figure. | |
| **Sequence of Transformations** | | |
| **153.b** | i. Describe a sequence of transformations that would move a figure onto a figure that is similar. | |
| **Properties of Dilations** | | |
| **153.c** | i. Create a dilated figure using *tools*. Then, describe the effect that the dilation has on line segments.<br><br>*Graph paper, tracing paper, or geometry software* | |
| | ii. Create a dilated figure using *tools*. Then, describe the effect that the dilation has on angles.<br><br>*Graph paper, tracing paper, or geometry software* | |
| **Definition of Similarity** | | |
| **153.d** | i. Write an argument for why two figures are similar. | |
| | ii. Write an argument for why two figures are not similar. | |
| | iii. Use the definition of dilation within an argument about similarity. | |
| **Similarity Transformations** | | |

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| **153.e** | i. Show an example to illustrate that similar figures have corresponding angles that are equal in measure. | |
| | ii. Explain in general why similar figures have corresponding angles that are equal in measure. | |
| | iii. Show an example to illustrate that similar figures have corresponding sides that are proportional. | |
| | iv. Explain in general why similar figures have corresponding sides that | |
| | **Indicator** | ***Notes*** |
| | are proportional. | |
| **Similarity Transformations** | | |
| **153.f** | i. Show an example illustrating that if two figures have two corresponding angles that are equal in measure, then they are similar. | |
| | ii. Explain in general why figures that have two corresponding angles that are equal in measure are similar. | |
| **Proving Theorems Using Similarity** | | |
| **153.g** | i. Read a proof of a statement about triangles and explain it in your own words. | |
| | ii. Write a proof for a statement about triangles. | |
| **Solving Problems Using Similarity** | | |
| **153.h** | i. Find an unknown length measurement in a triangle using similarity. | |
| | i. Find an unknown angle measurement in a triangle using similarity. | |

# Student-Friendly Portfolio Indicators: M154

| | Indicator | *Notes* |
|---|---|---|
| **Conic Section—Circle and Parabola** | | |
| **154.a** | i. Explain how the Pythagorean theorem can be used to find the equation of a circle. | |
| | ii. Use the focus and directrix to write the equation for a parabola. | |
| **Proving Geometric Theorems** | | |
| **154.b** | i. Use the distance formula to find the distance between two points on a coordinate plane. | |
| | ii. Use coordinates, slope formula, distance formula, or midpoint formula to prove geometric theorems algebraically. | |
| | iii. Use coordinates to prove that a quadrilateral is, or is not, a specific quadrilateral. | |
| **Solving Problems About Parallel and Perpendicular Lines** | | |
| **154.c** | i. Classify lines or segments as parallel, perpendicular, or neither. | |
| | ii. Write the equation of a line that is parallel or perpendicular to a given line and passing through a given point. | |
| | iii. Solve problems involving equations of parallel and perpendicular lines. | |
| **Partitioning Line Segments** | | |
| **154.d** | i. Use a formula to find the coordinates of a point that partitions a line segment. | |

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|---|---|---|
| | ii. Use dilations to find the coordinates of a point that divides a line segment in a given ratio. | |
| **Determining Perimeter and Area** | | |
| **154.e** | i. Use coordinates to calculate perimeters of polygons and the areas of triangles and quadrilaterals. | |
| | **Indicator** | ***Notes*** |
| | ii. Use a coordinate plane to decompose figures into simple shapes and determine perimeter or area. | |

# Student-Friendly Portfolio Indicators: M155

| | Indicator | *Notes* |
|---|---|---|
| | **Trigonometric Ratios** | |
| **155.a** | i. Measure side lengths and angles of multiple triangles and describe patterns you see. | |
| | ii. Explain why trigonometric ratios remain the same for different-sized right triangles. | |
| | **Sine and Cosine of Complementary Angles** | |
| **155.b** | i. Use drawings or equations to show the relationship between the sine and cosine of complementary angles. | |
| | ii. Use the relationship between the sine and cosine of complementary angles to solve problems. | |
| | **Right Triangles** | |
| **155.c** | i. Use trigonometric ratios to find unknown side lengths in problems. | |
| | ii. Use trigonometric ratios to find unknown angles in problems. | |

# Student-Friendly Portfolio Indicators: M201

| | Indicator | *Notes* |
|---|---|---|
| **Understanding Functions** | | |
| **201.a** | i. Use function notation when describing functions. | |
| | ii. Show that explicit sequences and recursive sequences are functions. | |
| **Showing Key Features of Graphs** | | |
| **201.b** | i. Graph linear functions and show intercepts. Graph quadratic functions and show intercepts, and maxima or minima. | |
| | ii. Graph square root, cube root, piecewise, step, and absolute value functions. | |
| | iii. Graph polynomial functions and show the end behavior. When the polynomial can be factored, identify the zeros. | |
| | iv. Graph exponential functions and show the intercepts and end behavior. | |
| **Writing Functions in Equivalent Forms** | | |
| **201.c** | i. Factor and complete the square to rewrite expressions for quadratic functions. | |
| | ii. Use the properties of exponents to identify key features for exponential functions. | |
| | iii. Model situations by writing arithmetic and geometric sequences recursively and with a formula. | |
| **Building New Functions** | | |
| **201.d** | i. Identify how different values affect the graph of a function. When given two graphs, explain how one can be transformed into the other. | |

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| **Comparing Functions Represented in Different Ways** | | |
| **201.e** | i. Compare features of two functions represented in *different ways*.<br><br>*Algebraically, graphically, numerically in tables, or by verbal descriptions* | |
| **Building Functions for Two Quantities** | | |
| **201.f** | i. Identify the two variables in a situation or data set that show a functional relationship. | |
| | **Indicator** | ***Notes*** |
| | ii. Create a function that models the relationship between two quantities in a situation. | |

# Student-Friendly Portfolio Indicators: M202

| | Indicator | *Notes* |
|---|---|---|
| **Using the Properties of Exponents for Rational Exponents** | | |
| **202.a** | i. Explain how the properties of integer exponents can be used with rational exponents. | |
| | ii. Use the properties of exponents to rewrite expressions that have radicals and rational exponents. | |
| **Performing Operations With Complex Numbers** | | |
| **202.b** | i. Show understanding of complex numbers ($i^2 = -1$) and that every complex number has the form $a + bi$ with $a$ and $b$ being real numbers. | |
| | ii. Use the property $i^2 = -1$ and the commutative, associative, and distributive properties to add, subtract, and multiply complex numbers. | |
| **Using Complex Numbers in Polynomial Equations** | | |
| **202.c** | i. Solve quadratic equations with real coefficients that have complex solutions. | |

# Student-Friendly Portfolio Indicators: M203

| | Indicator | *Notes* |
|---|---|---|
| **Using the Structure of Polynomial and Rational Expressions** | | |
| **203.a** | i. Make connections between the *parts of an expression* and a real-world situation.<br>*Terms, factors, and coefficients* | |
| | ii. Describe the parts of a complicated expression. | |
| | iii. Use the structure of an expression to identify different ways to rewrite it. | |
| **Performing Operations With Polynomials** | | |
| **203.b** | i. Show an understanding that adding, subtracting, and multiplying polynomials result in a polynomial. | |
| | ii. Add, subtract, and multiply polynomials. | |
| **Understanding the Relationship Between Zeros and Factors of Polynomials** | | |
| **203.c** | I. Identify zeros of polynomials when factoring is possible. | |
| | ii. Use the zeros to construct a rough graph of a polynomial function. | |
| **Using Polynomial Identities To Solve Problems** | | |
| **203.d** | i. Prove polynomial identities. | |
| **Rewriting Rational Expressions** | | |
| **203.e** | i. Rewrite simple rational expressions in different forms. | |
| **Interpreting Polynomial and Rational Functions** | | |

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| **203.f** | i. Interpret *key features* of graphs and tables.<br>*Intercepts, intervals where the function is increasing and decreasing, positive or negative, relative maximums and minimums, symmetries, end behavior, and periodicity* | |
| | ii. Use a verbal description to sketch graphs showing *key features*.<br>*Intercepts, intervals where the function is increasing and decreasing, positive or negative, relative maximums and minimums, symmetries, end behavior, and periodicity* | |
| | iii. Calculate the average rate of change of a polynomial or rational | |
| | **Indicator** | ***Notes*** |
| | function over a specified interval. Explain what the average rate of change tells you about the polynomial or rational function. | |
| | iv. Use the quantities in the relationship to explain an appropriate domain of a function. | |

# Student-Friendly Portfolio Indicators: M204

| | Indicator | *Notes* |
|---|---|---|
| **Understanding the Relationship Between Exponential and Logarithmic Functions** | | |
| **204.a** | i. Explain the value of a logarithmic expression. | |
| | ii. Write an exponential expression to verify the value of a logarithmic expression. | |
| **Graphing Exponential and Logarithmic Functions** | | |
| **204.b** | i. Graph an exponential function over a domain that includes non-integers. | |
| | ii. Graph a logarithmic function. | |
| | iii. Explain the effect of changing the parts in an exponential or logarithmic function on its graph. | |
| **Interpreting Exponential and Logarithmic Functions** | | |
| **204.c** | i. Explain how an exponential graph relates to the story or situation being modeled. | |
| | ii. Explain how a logarithmic graph relates to the story or situation being modeled. | |
| | iii. Choose the domain for a logarithmic or exponential function based on the story or situation being modeled. Explain your choice. | |
| | iv. Calculate the average rate of change for an exponential or logarithmic function. Use the story or situation to explain the meaning of the average rate of change. | |
| **Using Logarithms To Analyze Exponential Models** | | |
| **204.d** | i. Create an exponential model for a story or situation. | |

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| | ii. Use a logarithm to solve for an unknown value in an exponential model. | |
| | iii. Tell how different values for exponential models relate to the situation being modeled. | |

# Student-Friendly Portfolio Indicators: M205

| | Indicator | *Notes* |
|---|---|---|
| **Understanding Radian Measures** | | |
| **205.a** | i. Use the definition of a radian to explain radian measure. | |
| | ii. Explain what an angle given in degrees would be in radians. | |
| **Understanding the Unit Circle** | | |
| **205.b** | i. Explain how radians make it possible to extend the domain of trigonometric functions. | |
| | ii. Use the unit circle to justify the value of sine, cosine, or tangent for an angle that is greater than 90 degrees. | |
| **Using the Unit Circle To Explain Symmetry** | | |
| **205.c** | i. Describe the symmetry of a trigonometric function. | |
| | ii. Use the unit circle to explain why a trigonometric function has symmetry. | |
| | iii. Describe the period of a trigonometric function. | |
| | iv. Use the unit circle to explain why a trigonometric function is periodic. | |
| **Graphing Trigonometric Functions** | | |
| **205.d** | i. Create the graph of a trigonometric function. | |
| | ii. Identify *key features* of the graph of a trigonometric function and connect these features back to the context of the problem.<br>*Period, amplitude, and frequency* | |
| | iii. Explain the relationship between the parts of a trigonometric function and its graph. | |
| **Modeling Periodic Phenomena** | | |

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| **205.e** | i. Create a trigonometric function to model a real-world situation. | |
| | ii. Use a trigonometric function to answer a question about a real-world situation. | |

# Student-Friendly Portfolio Indicators: M211

| | Indicator | *Notes* |
|---|---|---|
| | **Identifying Features That Make Graphs Misleading** | |
| **211.a** | i. Show an understanding that axis scale, truncated axes, and pictographs can exaggerate differences between values. | |
| | **Identifying Subjects and Variables in a Data Set** | |
| **211.b** | i. Identify who or what the subjects are in a data visualization, set of raw data, or study description. | |
| | ii. Identify what was collected or observed from the subjects in a data visualization, set of raw data, or study description. | |
| | iii. Show an understanding of what the *rows and columns* represent in a set of data and explain what they tell you about a data set.<br><br>*For example, rows represent subjects and columns represent variables measured* | |
| | **Comparing Graphs of Quantitative and Categorical Data** | |
| **211.c** | i. Summarize *key features* of graphs and explain what they tell you about the data.<br><br>*Shape, center, outliers, variability, or direction of trends* | |
| | ii. Compare key features of graphs and explain what they tell you about the data. | |
| | **Identifying Key Features of Quantitative and Categorical Data** | |
| **211.d** | i. Calculate measures of center and measures of spread. Identify outliers and other *summary statistics* of large data sets and explain their meanings. | |

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| | *Maximum, minimum, and skew* | |
| **Creating Graphs of Quantitative and Categorical Data** | | |
| **211.e** | i. Select appropriate types of visual representations for the type of data. | |
| | ii. Use appropriate tools to create visual representations of large data sets. | |
| | **Indicator** | ***Notes*** |
| **Preparing Data for Predictive Modeling** | | |
| **211.f** | i. Merge multiple data sources and explain why this is necessary. | |
| | ii. Make decisions to remove data observations or fill in missing values of data and justify these decisions. | |
| | iii. Filter or sort data to identify key features of data. | |
| | iv. Aggregate data to create new variables for the modeling process. Justify the need for these variables. | |
| **Understanding Where Data Comes From** | | |
| **211.g** | i. Distinguish between primary and secondary sources of data. | |
| | ii. Show an understanding of types of *sampling methods*.<br><br>*Voluntary response, random sampling, stratified random sampling, systematic random sampling, and web scraping* | |
| **Performing Data Practices** | | |
| **211.h** | i. Define and apply *data ethics*.<br><br>*Privacy, targeted advertising, location services, readability, and cookies* | |

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| | ii. Show an understanding of choosing sampling methods that responsibly prevent bias. | |

# Student-Friendly Portfolio Indicators: M212

| | Indicator | *Notes* |
|---|---|---|
| **Engaging in the Modeling Cycle** | | |
| **212.a** | i. Engage with the full modeling cycle—determine the problem, choose a strategy, find values, explain what the values mean, check that the values make sense, revise as necessary, share findings. | |
| **Constructing Questions for Predictive Modeling** | | |
| **212.b** | i. Differentiate between statistical and non-statistical questions. Recognize that a statistical question can be answered by collecting data and there may be variability in the data. | |
| | ii. Create statistical questions that can be answered using a predictive model. | |
| | iii. Suggest statistical questions that produce a given data model to answer those questions. | |
| | iv. Identify and define independent, dependent, and codependent relationships between potential variables in a data set. | |
| **Selecting Predictive Models To Answer Statistical Questions** | | |
| **212.c** | i. Identify the most appropriate *model* to use based on the statistical question, how the variables are measured, and type of data.<br><br>*Group versus regression models* | |
| | ii. Look at a model and either determine if data appears to fit the model or compare the coefficient of determination. | |
| **Understanding Data = Model + Error** | | |

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| **212.d** | i. For each observation, use a statistical model as a function that produces a predicted score. | |
| | ii. Differentiate between the empty model and a more complex model. | |
| | iii. Show an understanding of how to represent a linear relationship with a Least Squares Regression Line. Explain what the slope and y-intercept tell you about the situation. | |
| | **Indicator** | ***Notes*** |
| | iv. Understand that a perfect prediction does not usually exist by recognizing error visually. | |
| **Implementing Machine Learning Models** | | |
| **212.e** | i. Create linear models to fit data with one or more predictors. Use those models to predict outcomes. | |
| | ii. Implement at least one type of classification method to make a prediction. | |
| | iii. Implement at least one type of clustering method to make a prediction. | |
| **Improving Predictive Model Fit** | | |
| **212.f** | i. Show an understanding that some models visually appear to fit data better than other models. | |
| | ii. Use dimensionality reduction techniques to decrease the number of variables in a predictive model. | |
| | iii. Produce a predictive model that has transformed variables. | |
| **Using Predictive Models To Make Predictions** | | |
| **212.g** | i. Plug inputs into a predictive model to obtain an output, called a prediction. | |

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|---|---|---|
| | ii. Explain what an output from a predictive model means about the situation in a problem. When you can, include the appropriate units. | |
| | iii. Identify *limitations* of a predictive model. Explain what the intercepts/slope tell you about the situation being modeled.<br><br>*Trustworthiness of extrapolations* | |
| **Correlation and Causation** | | |
| **212.h** | i. Show an understanding that correlated variables do not suggest a causal relationship. | |
| | ii. Identify and state confounding variables. Explain what the confounding variable tells you about the situation. | |

# Student-Friendly Portfolio Indicators: M213

| | Indicator | *Notes* |
|---|---|---|
| | **Understanding Probability** | |
| **213.a** | i. Describe probability as a long run relative frequency. | |
| | ii. Show an understanding that probability is needed in the field of Data Science in order to obtain information from data. | |
| | **Determining Probability Using Bayesian Reasoning** | |
| **213.b** | i. Determine intersection probabilities using the conditional probability formula. | |
| | ii. Show and explain the connection across *representations* of compound probabilities.<br><br>*Tree diagrams, two-way tables* | |
| | **Understanding the Probability of Events** | |
| **213.c** | i. Use Bayesian reasoning to compare the compound probabilities of independent and dependent events. | |
| | ii. Show an understanding of the conditional probability formula, Bayes' theorem. | |
| | iii. Show an understanding that a connection that exists between variables may disappear or reverse when observing subgroups. | |
| | iv. Describe a situation where two events are independent. | |
| | **Making Predictions** | |
| **213.d** | i. Make predictions for at least one type of discrete probability distribution. | |

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| | ii. Make predictions for a normal distribution. | |
| | iii. Approximate a distribution to a normal curve in order to make predictions. | |
| **Using Sampling Distributions** | | |
| **213.e** | i. Create simulations to determine approximate sampling distributions. | |
| | **Indicator** | ***Notes*** |
| | ii. Explain how sampling distributions are used to describe the sample-to-sample variability of sample statistics. | |
| | iii. Make predictions using sampling distributions. | |

# Student-Friendly Portfolio Indicators: M214

| | Indicator | *Notes* |
|---|---|---|
| | **Understanding Variability** | |
| **214.a** | i. Use technology to calculate measures of *variability*. Explain what the measures tell you about the data.<br><br>*Sum of squares, mean absolute error, variance, standard deviation* | |
| | ii. Show an understanding that measures of variability can be used to determine predictive model fit. | |
| | iii. Show an understanding that predictive modeling is a way to explain variation of a response. | |
| | **Evaluating Predictive Modeling** | |
| **214.b** | i. Explain what Pearson's r tells you about a situation in a problem. Use Pearson' r to determine the strength of a linear relationship. | |
| | ii. Show an understanding that a correlation coefficient close to -1 or 1 does not necessarily mean that a linear model is appropriate. | |
| | iii. Estimate the value of Pearson's r between two variables visually using a scatterplot. Then use technology to calculate the value. | |
| | iv. Show an understanding of the effect outliers have on the value of Pearson's r. | |
| | v. Use technology to calculate the value of $R^2$. Explain what the value tells you about a situation in a problem. | |
| | **Using Residuals To Determine Model Fit** | |
| **214.c** | i. Use technology to produce residual summary statistics and residual plots for data sets. Use the residuals to determine how well the model fits the data. | |

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| | ii. Make decisions about predictive model fit using the standard deviation of residuals or using outliers, patterns, random scatter, or heteroskedasticity in residual plots. | |
| | **Comparing Predictive Models** | |
| **214.d** | i. Use one or more *statistical techniques* to check for improved | |
| | **Indicator** | ***Notes*** |
| | predictive model fit.<br><br>*F-tests, sensitivity analysis, transforming variables, adding or excluding variables, ANOVA, residual plots, normalizing variables, cross validation* | |
| | ii. Compare variability and Pearson's r of two or more predictive models to decide which model makes the best prediction. | |
| | iii. Use a process to improve a predictive model. | |
| | iv. Make predictions using the improved predictive model and explain what the predictions tell you about the situation in a problem. | |
| | **Understanding Bias-Variance Trade-Off** | |
| **214.e** | i. Show an understanding of bias-variance trade-off—a model with high bias tends to have low variance and a model with high variance tends to have low bias. | |
| | ii. Make decisions about a predictive model after weighing the bias-variance trade-off within the model. | |

# Student-Friendly Portfolio Indicators: M215

| | Indicator | *Notes* |
|---|---|---|
| **Calculating P-Values** | | |
| **215.a** | i. Use the appropriate probability distribution to produce a p-value. | |
| | ii. Explain what a p-value tells you about a situation in a problem. | |
| **Calculating Confidence Intervals** | | |
| **215.b** | i. Produce a margin of error for a parameter estimate. Explain how to increase or decrease the margin of error. | |
| | ii. Produce a confidence interval for a parameter estimate. | |
| | iii. Explain what a confidence level tells you about a situation and state appropriate assumptions. | |
| | iv. Explain what a confidence level tells you about a situation. | |
| **Conducting Informal Inference Testing** | | |
| **215.c** | i. Describe a null and alternative hypothesis for a given scenario. | |
| | ii. Check that conditions are met for conducting a hypothesis test. | |
| | iii. Identify if a p-value supports the rejection of a null hypothesis. | |
| **Using Bootstrapping** | | |
| **215.d** | i. Use a sampling distribution generated by a bootstrap method to estimate a population parameter. | |
| | ii. Show an understanding of the effect that sample size has on the bootstrap distribution. | |

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| | iii. Show an understanding of the effect that number of repeated samples has on the bootstrap distribution. | |
| **Making Conclusions About the Results From a Study** | | |
| **215.e** | i. Describe what Type I and Type II errors tell you about a scenario. | |
| | **Indicator** | ***Notes*** |
| | ii. Choose a significance level for statistical significance or confidence level and use that significance level to draw a conclusion about a hypothesis. | |
| | iii. Use various significance or confidence levels to draw conclusions about a hypothesis. | |
| | iv. Determine whether there is evidence to infer a causal relationship for a study with or without random assignment. | |
| | v. Determine whether results infer a generalization to the population for a study with or without random selection. | |