Math 3 Unit Skills Checklist

Unit 1 Modeling with Statistics

I can . . .

Use Normal Distributions

- ☐ Describe the characteristics of a standard normal curve.
- ☐ Use the mean and standard deviation of a data set to fit it to a normal distribution.
- ☐ Estimate population percentages based on a normal distribution with given mean and standard deviation.
    - Apply the Empirical Rule to estimate probabilities for normal distributions.
    - Use calculators, spreadsheets, and tables to estimate areas under the normal curve.
- ☐ Calculate a z-statistic (z-score) and explain its meaning in context.
- ☐ Describe types of data sets for which it is not appropriate to fit a normal distribution.

Sampling and Study Design

- ☐ Explain the purposes of and differences among sample surveys, experiments, and observational studies.
- ☐ Explain how randomization relates to sample surveys, experiments, and observational studies.
- ☐ Make inferences and justify conclusions from sample surveys, experiments, and observational studies.
- ☐ Identify and describe types of bias that might be present in a data collection process.
- ☐ Write appropriate, non-biased survey questions to gather data.
- ☐ Compare different types of sampling (simple random, systematic, convenience, cluster, stratified) and describe circumstances for when it is most appropriate to use each type.

Estimate Population Parameters

- ☐ Use data from a sample survey to estimate a population mean or proportion.
- ☐ Explain the difference between a population parameter and a sample statistic.
- ☐ Develop a margin of error through the use of simulation models for random sampling.
- ☐ Determine a sample size given a set margin of error.
- ☐ Use data from a randomized experiment to compare two treatments.
- ☐ Use simulations to decide if differences between parameters are significant.
- ☐ Use a random number table or random number generator on a calculator for a randomized selection process.
- ☐ Evaluate reports based on data.

Probability Distributions and Expected Value

- ☐ Use probabilities to make fair decisions (e.g., drawing by lots, using a random number generator).
- ☐ Analyze decisions and strategies using probability concepts (e.g., product testing, medical testing, pulling a hockey goalie at the end of a game).
- ☐ Apply probability concepts to real life situations.
- ☐ Calculate the expected value of a probability simulation.
- ☐ Determine whether a game is fair.

Unit 2 Modeling with Linear Functions

I can . . .

Solve systems of linear equations and inequalities

- ☐ Create equations in two or more variables to represent relationships between quantities.
- ☐ Solve systems of linear equations exactly, i.e. algebraically.
- ☐ Solve systems of linear equations approximately by graphing the functions using technology and estimating solutions, making tables of values, or finding successive approximations.
- ☐ Explain why the x-coordinates of the points where the graphs of the equations y = f(x) and y = g(x) intersect are the solutions of the equation f(x) = g(x).
- ☐ Graph the solutions to a linear inequality in two variables as a half- plane (excluding the boundary in the case of a strict inequality).
- ☐ Graph the solution set to a system of linear inequalities in two variables as the intersection of the corresponding half-planes.
- ☐ Represent constraints by systems of linear equations and/or inequalities based on a modeling context.
- ☐ Interpret solutions of linear systems as viable or non-viable options in a modeling context.
- ☐ Identify the feasible region for a set of constraints.
- ☐ Use the Corner Principle and the Objective Function to determine the optimum solution for a set of constraints in a modeling context.

Analyze linear functions using different representations

- ☐ Write arithmetic sequences both recursively using formal notation and with an explicit formula and use them to model situations.
- ☐ Translate between recursive and explicit forms of an arithmetic sequence.
- ☐ Identify the coefficients and constants of a function and interpret them in a contextual situation.
- ☐ For a linear function that models a relationship between two quantities, I can interpret the slope and y-intercept of the graph and table forms of the function in context.

- Relate the domain of a linear function to its graph and, when given a context, to the quantitative relationship it describes.

Use function notation

- Evaluate linear functions for inputs in their domains.
- Interpret statements that use function notation in terms of a context.

Build quadratic functions

- Write a linear function that describes the relationship between two quantities.

Prove geometric theorems

- Prove theorems about lines and angles:
    - Vertical angles are congruent.
    - When a transversal crosses parallel lines, alternate interior angles are congruent.
    - When a transversal crosses parallel lines, corresponding angles are congruent.
    - Points on a perpendicular bisector of a line segment are exactly equidistant from the segment's endpoints.
- Prove theorems about parallelograms.
    - Opposite sides are congruent.
    - Opposite angles are congruent.
    - The diagonals of a parallelogram bisect each other.
    - Rectangles are parallelograms with congruent diagonals.

Make geometric constructions

- Make formal geometric constructions with a variety of tools and methods (compass and straightedge, string, reflective devices, paper folding, dynamic geometric software, etc.).
    - Copy a segment.
    - Copy an angle.
    - Bisect a segment.
    - Bisect an angle.
    - Construct perpendicular lines, including the perpendicular bisector of a line segment.
    - Construct a line parallel to a given line through a point not on the line.
- Apply geometric concepts in modeling situations
- Apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize cost; working with typographic grid systems based on ratios).

Unit 3 Modeling with Polynomial Functions

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Use properties and operate with rational, irrational, and complex numbers

- ☐ Explain why the sum or product of two rational numbers is rational. (N-RN.3)
- ☐ Explain why the sum of a rational number and an irrational number is irrational. (N-RN.3)
- ☐ Explain why the product of a nonzero rational number and an irrational number is irrational. (N-RN.3)
- ☐ Add, subtract, and multiply complex numbers. (N-CN.2)

Solve quadratic equations and graph quadratic functions

- ☐ Solve quadratic equations with real coefficients that have complex solutions. (N-CN.7)
- ☐ Solve quadratic equations by inspection, taking square roots, factoring, completing the square, and using the quadratic formula. (A-REI.4a,b)
- ☐ Determine which method for solving a quadratic equation is most appropriate based on the initial form of the equation. (A-REI.4b)
- ☐ Derive the quadratic formula using the process of completing the square. (A-REI.4a)
- ☐ Recognize when the quadratic formula gives complex solutions and write them as $a \pm bi$ for real numbers a and b. (A-REI.4b)
- ☐ Show that the Fundamental Theorem of Algebra is true for quadratic polynomials. (N-CN.9)
- ☐ Complete the square in a quadratic expression to reveal the maximum or minimum value of the function it defines. (A-SSE.3b)
- ☐ 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. (F-IF.8a)
- ☐ Derive the equation of a parabola given a focus and directrix. (G-GPE.2)

Generalize concepts about quadratic functions to polynomials of higher degree

- ☐ Add, subtract, and multiply polynomials. (A-APR.1)
- ☐ Solve polynomial equations and systems of polynomial equations approximately by using technology to graph the functions they define. (A-REI.11)
- ☐ Identify zeros of polynomials when suitable factorizations are available, and use the zeros to construct a rough graph showing key features of the function defined by the polynomial. Key features include intercepts, relative maxima and minima, and end behavior. (A-APR.3, F-IF.7c)
- ☐ Prove polynomial identities and use them to describe numerical relationships. (A-APR.4)

Unit 4 Modeling with Expressions and Equations

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- ☐ Factor polynomials and use factoring to simplify rational expressions. (A-APR.6, A-APR.7)
- ☐ Factor by grouping, factor perfect cubes, and factor higher order sums and differences. (A-APR.6, A-APR.7)
- ☐ Rewrite rational expressions in different forms. (A-APR.6, A-APR.7)
- ☐ Write $\frac{a(x)}{b(x)}$ in the form $q(x) + \frac{r(x)}{b(x)}$, where $a(x)$, $b(x)$, $q(x)$, and $r(x)$ are polynomials and the degree of $r(x)$ is less than the degree of $b(x)$. (A-APR.6, A-APR.7, A-APR.2)
- ☐ Find the quotient of two polynomials by: (A-APR.6, A-APR.7)
  - inspection.
  - using long division.
  - using synthetic division.
  - using a computer algebra system.
- ☐ Add, subtract, multiply, and divide rational expressions. (A-APR.7)
- ☐ Calculate partial fractions from rational expressions.
- ☐ Create and solve rational equations in one-variable and use them to solve problems. (A-CED.1, A-REI.2)
- ☐ Solve rational equations approximately by graphing the corresponding functions using technology and estimating solutions, making tables of values, or finding successive approximations. (A-REI.11)
- ☐ Solve rational and radical equations algebraically and give examples of how extraneous solutions may arise.

Unit 5 Modeling with Advanced Functions

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Exponential and Logarithmic Expressions, Equations, and Functions

- ☐ Use technology to evaluate logarithms.
- ☐ Use the properties of logs to simplify or expand logarithmic expressions.
- ☐ Solve exponential and logarithmic equations approximately by using technology, making tables of values, or finding successive approximations.
- ☐ Solve exponential equations algebraically using logs.
  - Express as a logarithm the solution to $ab^{ct} = d$, where a, c, and d are numbers and the base b is 2, 10, or e.
  - Express as a logarithm the solution to $ab^{ct} = d$, where a, c, and d are numbers and the base $b > 0$.
- ☐ Solve logarithmic equations algebraically using the properties of logs.

- ☐ Solve a system of equations that include exponential and/or logarithmic functions using technology.
- ☐ Graph exponential and logarithmic functions showing the intercepts and end behavior.
- ☐ Compare rates of growth for different functions (linear, quadratic, exponential, and polynomial) using tables and graphs.

Inverse Functions

- ☐ Determine whether a function has an inverse using the horizontal line test.
- ☐ Find the inverse of a simple function algebraically, if it exists.
- ☐ Read values of an inverse function from a graph or table.
- ☐ Produce a function that has an inverse from one that does not by restricting the domain.

Geometric Sequences

- ☐ Determine whether a sequence is arithmetic, geometric or neither.
- ☐ Determine the common ratio for a geometric sequence.
- ☐ Write a geometric sequence using formal recursive function notation.
- ☐ Convert between recursive and explicit forms of a geometric sequence.
- ☐ Derive the formula for the sum of a finite geometric series (when the common ratio is not 1).
- ☐ Use the formula for the sum of a finite geometric series to solve problems (e.g. calculate mortgage payments).
- ☐ Find a partial sum for a geometric series.
- ☐ Find an infinite sum for a geometric series.
- ☐ Use sigma notation to represent a geometric series.

Unit 6 : Modeling with Trigonometric Functions

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Trigonometric Functions:

- ☐ Graph sine and cosine and tangent functions by hand in simple cases and using technology for more complicated cases, showing period, midline, and amplitude, vertical shift. (F-IF.7)
- ☐ Explain how the unit circle in the coordinate plane enables the extension of the domain of trigonometric functions to all real numbers. (F-TF.2)
- ☐ Convert radians to degrees and degrees to radians. (F-TF.1)
- ☐ *Convert degrees expressed in standard form to degrees, minutes, seconds. (F-TF-1)*
- ☐ Create trigonometric functions to model periodic phenomena with specified amplitude, frequency, and midline. (F-TF.5)
- ☐ Prove the Pythagorean identity $\sin^2(\theta) + \cos^2(\theta) = 1$ and use it to find $\sin(\theta)$, $\cos(\theta)$, or $\tan(\theta)$ given $\sin(\theta)$, $\cos(\theta)$, or $\tan(\theta)$ and the quadrant of the angle. (F-TF.8)

Triangles and Similarity:

- Given two figures, use the definition of similarity (in terms of similarity transformations) to decide if they are similar. (G-SRT.2)
- Use the properties of similarity transformations to establish the AA Similarity criterion for two triangles to be similar. (G-SRT.3)
- Use congruence and similarity criteria for triangles to solve problems and to prove relationships in geometric figures. (G-SRT.5)
- Prove that the base angles of an isosceles triangle are congruent. (G-CO.10)
- Prove that the medians of a triangle meet at a point. (G-CO.10)
- Prove that a line parallel to one side of a triangle divides the other two sides proportionally.
- Prove the Pythagorean Theorem using triangle similarity.
- Prove that all circles are similar. (G-C.1)

Circles:

- Identify and describe relationships among inscribed angles, radii, and chords, including:
    - The relationship between central, inscribed, and circumscribed angles.
    - Inscribed angles that intercept the endpoints of a diameter are right angles.
    - The radius of a circle is perpendicular to the tangent where the radius intersects the circle. (G-C.2)
- Construct the inscribed and circumscribed circles of a triangle. (G-SRT.5 & G-C.3)
- Prove that the opposite angles of a quadrilateral inscribed in a circle are supplementary. (G-C.3)
- Derive using similarity the fact that the length of the arc intercepted by an angle is proportional to the radius. (G-C.5)
- Derive the formula for the area of a sector. (G-C.5)
- Derive the equation of a circle of given center and radius using the Pythagorean Theorem. (G-GPE.1)
- Complete the square to find the center and radius of a circle given by an equation. (G-GPE.1)

Modeling:

- Apply geometric methods to solve design problems. (G-MG.3)