Specific Examples of Ways to Address Math GE Learning Outcomes

Math 1030: Quantitative Reasoning

#1 Know when and how to apply mathematical knowledge to real world problems.

- Understand and explain the function of the check-digit in barcodes.
- Use a specified voting system to determine the "winner" of an election.
- Solve problems involving interest (simple, compound, continuous), loans, and annuities.
- Solve problems using mathematical models that are linear, quadratic, exponential, or logarithmic. Use logarithms to answer questions of how long it will take a quantity to grow / decay to a specified amount.
- Be able to convert between units or different number bases / systems.

#2 Interpret and critique quantitative information or arguments

- Determine whether a given series of steps constitutes a valid proof of the Pythagorean Theorem.
- Decide whether a given financial scenario will result is a specified interest rate (or APY).

#3 Construct quantitative, logical arguments.

- Prove that $\sqrt{2}$ (or another irrational number) is irrational.
- Using an appropriate diagram, prove the Pythagorean Theorem.
- Use Venn diagrams to model and solve problems involving sets.
- Show that in the world there are two non-bald people with the same number of hairs on their head. (Use pigeon hole principle.)

#4 Understand and use mathematics as a language to communicate.

- Accurately convert between mathematical notation or expressions and a written or oral narrative.
- Give a correct sentence to describe both absolute and percent change in a given quantity and interpret such statements about change.
- Use function notation and parentheses correctly in solving problems.
- Express answers with appropriate units.

#5 Explore and analyze mathematical concepts, using technology as appropriate.

- Analyze fractals (perimeter, area, dimension) using software or scientific calculators where needed.
- Use a non-graphing scientific calculator to compute the length of time needed to reach a desired amount for a real world (non-contrived) exponential growth/decay problem.
- Compute the standard deviation of a data set of 10 or more values.

#6 Estimate, reason through, and make sense of mathematical processes and results.

- Determine whether a given balance is reasonable for a suitable interest rate and amount of time.
- Decide whether a given response is a reasonable approximation to a real world problem.
- Prove that $\sqrt{2}$ (or another irrational number) is irrational.

Math 1040: Intro. to Statistics

#1 Know when and how to apply mathematical knowledge to real world problems.

- Determine an appropriate measure of central tendency (mean, median, mode) and compute it for a given data set.
- Create an accurate visual representation (graph) for a given data set.
- Use z-scores to compute probabilities for normally distributed data or data from sets that can be modeled by the normal distribution.
- Accurately complete a hypothesis test or confidence interval and interpret in real world terms.
- Compute probabilities to determine whether a given event is likely or unlikely. Then use the probabilities to draw a conclusion. For example, is a committee of 8 men and 4 women (with a population of equal men and women) evidence of discrimination?

#2 Interpret and critique quantitative information or arguments

- Given the data and results from a suitable hypothesis test, determine if a given conclusion is warranted.
- Analyze a suitable study to determine if there may be bias and whether the findings are valid.
- Given a passage with basic statistics (such as from a newspaper story), correctly articulates how those statistics could have been calculated and their potential meaning.

#3 Construct quantitative, logical arguments.

- Accurately complete a hypothesis test or confidence interval and interpret in real world terms.
- Use graphs, diagrams, and charts to compare data sets and draw correct conclusions.

#4 Understand and use mathematics as a language to communicate.

- Accurately convert between mathematical notation or expressions and a written or oral narrative.
- Interpret results from a hypothesis test or confidence interval in real world terms.
- Use probabilities to communicate the likelihood of an event (winning the lottery, etc.)

#5 Explore and analyze mathematical concepts, using technology as appropriate.

- Use technology (TI-8X calculator, Excel, or statistics software) to compute the test statistic or P-value for a hypothesis test.
- Use technology (TI-8X calculator, Excel, or statistics software) to compute a confidence interval.
- Use technology (TI-8X calculator, Excel, or statistics software) to compute a compound binomial probability.

#6 Estimate, reason through, and make sense of mathematical processes and results.

- Given a scatterplot of bivariate data, estimate the r-value (linear correlation coefficient).
- Based on summary statistics or a graph, make an educated guess about the conclusion of a hypothesis test.

Math 1050: College Algebra

#1 Know when and how to apply mathematical knowledge to real world problems.

- Solve an exponential growth/decay equation for the desired time by using logarithms.
- Solve logarithmic equations and exclude extraneous solutions.
- Maximize the profit equation given quadratic cost and revenue functions.
- Use series to compute the balance of a compound interest problem.
- Calculate probabilities using combinations or permutations.
- Use linear programming to find an optimal solution to a given problem.

#2 Interpret and critique quantitative information or arguments

- Determine whether a given sequence of steps constitutes a valid line of reasoning (such as a proposed proof of a mathematical theorem or solution to a quantitative problem). If not a valid method, is able to explain why not.

#3 Construct quantitative, logical arguments.

- Find the maximum or minimum of a quadratic function that models real world data.
- Construct a polynomial given its zeros.
- Simplify and solve quadratic, rational, exponential, and logarithmic equations in a logical, step-by-step fashion.

#4 Understand and use mathematics as a language to communicate.

- Accurately convert between mathematical notation or expressions and a written or oral narrative.
- Use function notation and parentheses correctly in solving problems
- Create / Use graphs to describe and explain the behavior of polynomial, exponential, rational, logarithmic, and piecewise equations.
- Convert a system of linear equations to a matrix equation.

#5 Explore and analyze mathematical concepts, using technology as appropriate.

- Solve a system of 3 (or more) equations in 3 (or more) unknowns using matrix algebra.
- Explore the effect on the balance of changing the interest rate for a fixed time period.
- Use a scientific calculator to compute the time for an investment to reach a predetermined value.

#6 Estimate, reason through, and make sense of mathematical processes and results.

- Use estimation of known logarithmic and exponential values to aid in checking answers of more difficult questions.
- Use college algebra techniques to sketch the graph of a polynomial function.

Math 1210: Calculus I

#1 Know when and how to apply mathematical knowledge to real world problems.

- Use derivatives and integrals to solve problems involving position, velocity, and acceleration.
- Solve related rates problems and optimization problems.
- Correctly use an integral to compute the volume or surface area of a solid of revolution.

#2 Interpret and critique quantitative information or arguments

- Determine whether a given sequence of steps constitutes a valid line of reasoning (such as a proposed proof of a mathematical theorem or solution to a quantitative problem). If not a valid method, is able to explain why not.
- Use a velocity equation to determine when a particle is moving forward, backward, or is stopped.

#3 Construct quantitative, logical arguments.

- Construct valid δ-ε arguments for limits.
- Understand requirements for major theorems and use them to draw conclusions (ie a continuous function is positive at one input value and negative at another so the Intermediate Value Theorem guarantees that the function must have been zero at least once in the interval.)
- Given an equation or scenario, apply calculus techniques to determine a desired (local) maximum or minimum. Student can also verify that said point is a (local) maximum or minimum using the First Derivative Test or Second Derivative Test.
- Analyze a table, graph, or function to calculate / approximate average and instantaneous rates of change.
- Given a table, graph, or function, students approximate the area under the curve. For example, given a velocity function, the area under the curve yields position.

#4 Understand and use mathematics as a language to communicate.

- Students understand symbols and notation and can use them appropriately. For example, a student completes a limit statement by finding the delta value for any given epsilon.
- Students translate related rates and optimization scenarios into mathematics, use calculus to solve the problem, and then report the answer in real-world terms.

#5 Explore and analyze mathematical concepts, using technology as appropriate.

- After finding a tangent line, use a graphing calculator or Computer Algebra System (CAS) to graph the tangent line to a function at the given point.
- Completes chapter projects using Maple (R), Mathematica (R), or Maxima software.

#6 Estimate, reason through, and make sense of mathematical processes and results.

- Use knowledge of graphs to estimate the limit of a suitable function.
- Estimate an answer to a problem (such as related rates, optimization, volume of revolution, arc length) and verify that the computed response is reasonably close to the estimate
- Determine whether a possible solution to an optimization problem is feasible.