J. Sargeant Reynolds Community College
Course Content Summary

Course Prefix and Number: MTH 154   **Credits:** 3

Course Title: Quantitative Reasoning

Course Description: Presents topics in proportional reasoning, modeling, financial literacy, and validity studies (logic and set theory). Major emphasis is on the process of taking a real-world situation, identifying the mathematical foundation needed to address the problem, solving the problem, and applying what is learned to the original situation. Replaces MTH 151, MTH 152, MTH 158, or MTH 170. Prerequisite: Competency in MTE 1-5 as demonstrated through placement or unit completion or equivalent or co-enrollment in MCR 4. Lecture 3 credits per week.

General Course Purpose: Students entering degree programs and career fields in non-STEM areas who need strong problem-solving and decision-making skills will benefit from taking this course. The course's nontraditional treatment of content will help students develop conceptual understanding by supporting them in making connections between concepts and applying previously learned material to new contexts. The course will help to prepare students for success in future courses, gain skills for the workplace, and participate as productive citizens in our society.

Course Prerequisites and Co-requisites:
Prerequisite: Competency in MTE 1-5 as demonstrated through placement or unit completion or equivalent or co-enrollment in MCR 4

Course Objectives:
Upon completing the course, the student will be able to
1. Draw conclusions or make financial decisions using quantitative information
   (Simple Interest)
   - Define interest and understand related terminology.
   - Develop simple interest formula.
   - Use simple interest formulas to analyze financial issues.
   (Compound Interest)
   - Describe how compound interest differs from simple interest.
   - Explain the mechanics of the compound interest formula, addressing items such as why the exponent and $(1 + r/n)$ is used.
   - Use compound interest formulas to analyze financial issues.
   - Show the difference between compound interest and simple interest using a table or graph.
   (Borrowing)
   - Compute payments and charges associated with loans.
   - Identify the true cost of a loan by computing APR.
   - Evaluate the costs of buying items on credit.
   - Compare loans of varying lengths and interest rates.
   (Investing)
   - Calculate the future value of an investment and analyze future value and present value of annuities.
   - Calculate profit from a sale of an investment.

- Compare various investment options and understand when it is appropriate to utilize them.

2. Draw conclusions and/or make decisions based on analysis and critique of quantitative information using proportional reasoning
   - Solve real-life problems requiring interpretation and comparison of complex numeric summaries, which extend beyond simple measures of center.
   - Solve real-life problems requiring interpretation and comparison of various representations of ratios (i.e., fractions, decimals, rates, and percentages).
   - Distinguish between proportional and non-proportional situations and, when appropriate, apply proportional reasoning. Recognize when proportional techniques do not apply.
   - Solve real-life problems requiring conversion of units using dimensional analysis.
   - Apply scale factors to perform indirect measurements (e.g., maps, blueprints, concentrations, dosages, and densities).
   - Order real-life data written in scientific notation. (The data should include different significant digits and different magnitudes.)
   - Effectively justify and communicate conclusions in ways appropriate to the audience

3. Use mathematical methods of analysis to understand the requirements of a problem, create an equation or program that allows prediction and interpretation of quantitative elements of the problem and solution (including limitations of each), and critique the resulting mathematical model for accuracy and validity
   (Observation)
   - Through an examination of examples, study physical systems in the real world by using abstract mathematical equations or computer programs.
   - Make measurements of physical systems and relate them to the input values for functions or programs.
   - Compare the predictions of a mathematical model with actual measurements obtained.
   - Quantitatively compare linear and exponential growth.
   - Explore the mathematical and logical structures that enable familiar models encountered in daily life: weather, financial, simple physical, and normal and exponential population models.
   (Mathematical Modeling and Analysis)
   - Assemble measurements and data gathered (possibly through surveys, Internet, etc.) into tables, displays, charts, and simple graphs.
   - Explore interpolation and extrapolation of linear and non-linear data. Determine the appropriateness of interpolation and/or extrapolation.
   - Identify and distinguish linear and non-linear data sets arrayed in graphs and identify when a linear or non-linear model or trend is reasonable for given data or context.
   - Correctly associate a linear equation in two variables with its graph on a numerically accurate set of axes.
   - Numerically distinguish which one of a set of linear equations is modeled by a given set of (x,y) data points.
   - Identify a mathematical model's boundary values and limitations (and related values and regions where the model is undefined). Identify this as the domain of an algebraic model.
   - Using measurements (or other data) gathered and a computer program (spreadsheet or GDC) to create different regressions (linear and non-linear), determine the best model, and use the model to estimate future values.
   (Application)
   - Starting with a verbally described requirement, generate an appropriate mathematical

approach to creating a useful mathematical model for analysis.
- Explore the graphical solutions to systems of simultaneous linear equations and their real world applications.
- Numerically analyze and mathematically critique the utility of specific mathematical models: instructor-provided, classmate generated, and self-generated.

4. Identify invalid and unsupported chains of reasoning and employ methods from the mathematical disciplines of Set Theory and Logic to develop internally consistent arguments and conclusions
   a. Identify logical fallacies in popular culture: political speeches, advertisements, and other attempts to persuade.
   b. Relate the concept of a "statement" to the notion of Truth Value. Identify statements and non-statements.
   c. Describe the differences between verbal expression of truth and mathematical expression of truth. Discuss the usefulness of symbolic representation of statements. Discuss the two-valued nature of mathematical truth value and relate this to real world examples.
   d. Determine the logical equivalence between two different verbal statements (simple and compound) in real-world context.
   e. Relate the language of conditionals to the language of quantified statements.
   f. Explore the relationship between quantified statements and conditional statements (e.g., "All scientists are educated" is equivalent to "If she is a scientist then she is educated").
   g. Apply concepts of symbolic logic and set theory to examine compound statements and apply that to decision making of real-world applications.

Major Topics to Be Included:
1. Financial Literacy—Interest, Borrowing, Investing
2. The Perspective Matters—Number, Ratio, and Proportional Reasoning
3. Modeling—Observation, Mathematical Modeling and Analysis, Application
4. Validity Studies—Statements, Conclusions, Validity and Bias, Logic, Set Theory

Effective Date of Course Content Summary: August 3, 2017