NOVA COLLEGE-WIDE COURSE CONTENT SUMMARY
MTH 154 – QUANTITATIVE REASONING (3 CR.)

Course Description

Presents topics in proportional reasoning, modeling, financial literacy and validity studies (logic and set theory). Focuses 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. **This is a Passport and UCGS transfer course.** Total 3 hours per week.

General Course Purpose

The Quantitative Reasoning course is organized around big mathematical concepts. 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. Encourage students to do mathematics with real data. This includes recognizing the real world often has less than perfect data, ambiguities and multiple possible solutions. It also means equipping students to be intelligent consumers of quantitative data and reports. Encourage students to engage in productive struggle to learn mathematics and make connections to the world in which they live.

Course Prerequisites/Corequisites

Prerequisite: MDE 10, or direct placement.

Course Objectives

a) Communication
   a. Interpret and communicate quantitative information and mathematical and statistical concepts using language appropriate to the context and intended audience.
      i. Use appropriate mathematical language in oral, written and graphical forms.
      ii. Read and interpret real world advertisements, consumer information, government forms and news articles containing quantitative information.
      iii. Use quantitative information from multiple sources to make or critique an argument.
b) Problem Solving
   a. Make sense of problems, develop strategies to find solutions, and persevere in solving them.
      i. Develop an answer to an open-ended question requiring analysis and synthesis of multiple calculations, data summaries, and/or models.
      ii. Develop personal problem solving processes and apply them to applications studied over an extended period of time.
c) Reasoning
   a. Reason, model, and draw conclusions or make decisions with quantitative information.
      i. Draw conclusions or make decisions in quantitatively based situations that are dependent upon multiple factors. Students will analyze how different situations would affect the decisions.
      ii. Present written or verbal justifications of decisions that include appropriate discussion of the mathematics involved.
      iii. Recognize when additional information is needed or the appropriate times to simplify a problem.
d) Evaluation
   a. Critique and evaluate quantitative arguments that utilize mathematical, statistical, and quantitative information.
      i. Evaluate the validity and possible biases in arguments presented in real world contexts based on multiple sources of quantitative information - for example; advertising, internet postings, consumer information, political arguments.

e) Technology
   a. Use appropriate technology in a given context.
      i. Use a spreadsheet to organize quantitative information and make repeated calculations using simple formulas.
      ii. Explore internet-based tools appropriate for a given context - for example, an online tool to calculate credit card interest or a scheduling software package.
f) Financial Literacy
   a. Simple Interest
      i. Define interest and understand related terminology.
      ii. Develop simple interest formula.
      iii. Use simple interest formulas to analyze financial issues
   b. Compound Interest
      i. Describe how compound interest differs from simple interest.
      ii. Explain the mechanics of the compound interest formula addressing items such as why the exponent and $(1+r/n)$ is used.
      iii. Use compound interest formulas to analyze financial issues
      iv. Show the difference between compound interest and simple interest using a table or graph.
   c. Borrowing
      i. Compute payments and charges associated with loans.
      ii. Identify the true cost of a loan by computing APR
      iii. Evaluate the costs of buying items on credit
      iv. Compare loans of varying lengths and interest rates.
   d. Investing
      i. Calculate the future value of an investment and analyze future value and present value of annuities (Take into consideration possible changes in rate, time, and money.)
      ii. Calculate profit from a sale of an investment
      iii. Compare various investment options and understand when it is appropriate utilize them
g) Perspective Matters - Number, Ratio, and Proportional Reasoning
   a. Solve real-life problems requiring interpretation and comparison of complex numeric summaries which extend beyond simple measures of center.
   b. Solve real-life problems requiring interpretation and comparison of various representations of ratios (i.e., fractions, decimals, rates, and percentages).
   c. Distinguish between proportional and non-proportional situations and, when appropriate, apply proportional reasoning. Recognize when proportional techniques do not apply.
   d. Solve real-life problems requiring conversion of units using dimensional analysis.
   e. Apply scale factors to perform indirect measurements (e.g., maps, blueprints, concentrations, dosages, and densities).
   f. Order real-life data written in scientific notation. The data should include different significant digits and different magnitudes.
h) Modeling
   a. Observation
      i. Through an examination of examples, develop an ability to study physical systems in the real world by using abstract mathematical equations or computer programs
      ii. Make measurements of physical systems and relate them to the input values for functions or programs. Examples: measure distance and time for a toy car, length of candle and time as it burns, length of vertical spring under different weights attached (linear); temperature and time for a refrigerated liquid as it warms (nonlinear)
      iii. Compare the predictions of a mathematical model with actual measurements obtained
      iv. Quantitatively compare linear and exponential growth
      v. Explore the mathematical and logical structures that enable familiar models encountered in daily life: Weather models, Financial models, Simple physical models, Normal and Exponential Population Models.
   b. Mathematical Modeling and Analysis
      i. Assemble measurements and data gathered (possibly through surveys, internet, etc.) into tables, displays, charts, and simple graphs.
      ii. Explore interpolation and extrapolation of linear and non-linear data. Determine the appropriateness of interpolation and/or extrapolation.

iii. Identify and distinguish linear and non-linear data sets arrayed in graphs. Identifying when a linear or non-linear model or trend is reasonable for given data or context.

iv. Correctly associate a linear equation in two variables with its graph on a numerically accurate set of axes

v. Numerically distinguish which one of a set of linear equations is modeled by a given set of (x,y) data points

vi. 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.

vii. 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.

c. Application

i. Starting with a verbally described requirement, generate an appropriate mathematical approach to creating a useful mathematical model for analysis

ii. Explore the graphical solutions to systems of simultaneous linear equations, and their real world applications

iii. Numerically analyze and mathematically critique the utility of specific mathematical models: instructor-provided, classmate generated, and self-generated

i) Validity Studies

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 2-valued nature of mathematical truth value, 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

a) Financial Literacy (Interest, Borrowing, and Investing)
b) Perspective (Complex Numeric Summaries, Ratios, Proportions, Conversions, Scaling, Scientific Notation)
c) Modeling (Observation, Mathematical Modeling and Analysis, Application)
d) Validity Studies (Statements, Conclusions, Validity, Bias, Logic, Set Theory)