

Virginia Western Community College

MTH 154

Quantitative Reasoning

Prerequisites

Satisfies MTE 1-5 or MDE 10; or Corequisite MDE 54

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.

Semester Credits: 3

Lecture Hours: 3

Required Materials

Textbook:

Using and Understanding Mathematics: A Quantitative Reasoning Approach. Bennett, Briggs. 7th edition. Pearson. ISBN: 9780135903551.

Other Required Materials:

Scientific Calculator

Course Outcomes

At the completion of this course, the student should be able to:

- Communication
 - Interpret and communicate quantitative information and mathematical and statistical concepts using language appropriate to the context and intended audience.
 - Use appropriate mathematical language in oral, written and graphical forms.
 - Read and interpret real world advertisements, consumer information, government forms and news articles containing quantitative information.
 - Use quantitative information from multiple sources to make or critique an argument.
- Problem Solving
 - Share strategies to find solutions to life application problems to make sense of the mathematical content and persevere in solving them.
 - Apply strategies for solving open-ended questions requiring analysis and synthesis of multiple calculations, data summaries, and/or models.
 - Apply problem solving strategies to applications requiring multiple levels of engagement.
- Reasoning
 - Reason, model, and draw conclusions or make decisions with quantitative information.

- 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.
- Present written or verbal justifications of decisions that include appropriate discussion of the mathematics involved.
- Recognize when additional information is needed.
- Recognize the appropriate ways to simplify a problem or its assumptions.
- Evaluation
 - Critique and evaluate quantitative arguments that utilize mathematical, statistical, and quantitative information.
 - 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.
- Technology
 - Use appropriate technology in a given context.
 - Use a spreadsheet to organize quantitative information and make repeated calculations using simple formulas.
 - Search for and apply internet-based tools appropriate for a given context - for example, an online tool to calculate credit card interest or a scheduling software package.
- Financial Literacy
 - Simple Interest
 - Define interest and its related terminology.
 - Develop simple interest formula.
 - Use simple interest formulas to analyze financial issues
 - Compound Interest
 - Compare and contrast compound interest and simple interest.
 - Explore the mechanics of the compound interest formula addressing items such as why the exponent and $(1+r/n)$ is used by building the concept of compounding interest through manual computation of a savings or credit account.
 - Apply compound interest formulas to analyze financial issues
 - Create a table or graph to show the difference between compound interest and simple interest.
 - 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 total loan cost using varying lengths and interest rates.
 - Investing
 - 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.)
 - Compare two stocks and justify your desire to buy, sell, or hold stock investment.
 - Explore different types of investment options and how choices may impact one's future such as in retirement.
- Perspective Matters - Number, Ratio, and Proportional Reasoning
 - Solve real-life problems that include interpretation and comparison of summaries which extend beyond simple measures, such as weighted averages, indices, or ranking and evaluate claims based on them.

- Solve real-life problems requiring interpretation and comparison of various representations of ratios (i.e., fractions, decimals, rates, and percentages including part to part and part to whole, per capita data, growth and decay via absolute and relative change).
- Distinguish between proportional and non-proportional situations and, when appropriate, apply proportional reasoning leading to symbolic representation of the relationship. 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.
- Modeling
 - Observation
 - Through an examination of examples, develop an ability to study physical systems in the real world by using abstract mathematical equations or computer programs
 - Collect 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 behind the scenes of familiar models encountered in daily life (such as weather models, simple physical models, population models, etc.)
 - Mathematical Modeling and Analysis
 - Collect measurements and data gathered (possibly through surveys, internet, etc.) into tables, displays, charts, and simple graphs.
 - Create graphs and charts that are well-labeled and convey the appropriate information based upon chart type.
 - 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. Identifying 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
- Validity Studies
 - Identify logical fallacies in popular culture: political speeches, advertisements, and other attempts to persuade

- Analyze arguments or statements from all forms of media to identify misleading information, biases, and statements of fact.
- Develop and apply a variety of strategies for verifying numerical and statistical information found through web searches.
- Apply the use of basic symbolic logic, truth values, and set theories to justify decisions made in real-life applications, such as if-then-else statements in spreadsheets, Venn Diagrams to organize options, truth values as related to spreadsheet and flow-chart output. (Students must have experience with both symbolic logic and basic truth tables to meet this standard.)

Major Topics to be Included

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

Topical Description

Section	Topic
1A	Living in the Media Age (Fallacies)
1B	Propositions and Truth Tables
1C	Sets and Venn Diagrams
1D	Analyzing Arguments (Inductive and Deductive Reasoning)
2A	Understand, Solve, and Explain (Decimals and Percents)
2B	Extending Unit Analysis
3A	Uses and Abuses of Percentages
3B	Putting Numbers in Perspective (Scientific Notation)
3C	Dealing with Uncertainty
3D	Index Numbers: The CPI and Beyond
3E	How Numbers Can Deceive
4A	Taking Control of Your Finances
4B	The Power of Compounding
4C	Savings Plans and Investments
4D	Loan Payments, Credit Cards, and Mortgages
4E	Income Taxes
4F	Understanding the Federal Budget
5C	Statistical Tables and Graphs
5D	Graphs in the Media
6A	Characterizing Data
6B	Measures of Variation
8A	Growth: Linear vs. Exponential

8B	Doubling Time and Half-Life
8C	Real Population Growth
8D	Logarithmic Scales: Earthquakes, Sounds, and Acids
9A	Functions: The Building Blocks of Mathematical Models
9B	Linear Modeling
9C	Exponential Modeling
11A	Mathematics and Music
11B	Perspective and Symmetry
11C	Proportion and the Golden Ratio

Notes to Instructors

Pedagogical and Implementation Recommendations

- Use of Excel, Google Sheets, and/or internet-based tools to organize information and make calculations is recommended.