



## Final Math in Society (Math& 107) Course Description

A work group consisting of math faculty representing the public and private baccalaureate institutions in Washington and a representative group of math faculty from the community and technical colleges has created the description below outlining the critical outcomes and core content areas that define a rigorous terminal mathematics course for students in liberal arts and humanities majors. The course provides a solid foundation in the quantitative reasoning, symbolic reasoning, and critical thinking needed for citizenship and builds on the Standards for Mathematical Practice developed as part of the national Common Core State Standards for college readiness in mathematics:

1. *Make sense of problems and persevere in solving them.*
2. *Reason abstractly and quantitatively.*
3. *Construct viable arguments and critique the reasoning of others.*
4. *Model with mathematics.*
5. *Use appropriate tools strategically.*
6. *Attend to precision.*
7. *Look for and make use of structure*
8. *Look for and express regularity in repeated reasoning.*

### Course Outcomes – skills and abilities that result from the course:

- [MR] Mathematical Reasoning: Students will read a complex problem requiring quantitative and/or symbolic analysis, use flexibility in selecting a solution strategy, and impose an appropriate mathematical structure or mathematical procedure in solving the problem.
- [MH] Mathematical Habits of Thought: Students will determine the reasonableness and implications of mathematical solutions, and will recognize the limitations of the methods used in context.
- [MDM] Mathematical Decision-Making: Students will apply mathematical processes and solutions in making personal and societal choices.
- [MC] Mathematical Communication: Student will use appropriate representations to effectively communicate, orally and in writing, quantitative results and mathematical processes.
- [MS] Mathematical Symbols, Techniques & Computation: Students will demonstrate proficiency in the skills supporting mathematical understanding.

### Course Core Topics:

1. Proportional reasoning
2. The mathematics of personal finance
3. Probability
4. Descriptive statistics
5. Growth and decay models (linear and exponential)



While the core topics overlap in many ways with content addressed in calculus, statistics, and business pathways, the focus in Math &107 is on the “big ideas” in these areas—the aspects of growth, finance, and statistics that are essential knowledge for an educated citizenry—rather than an extensive emphasis on procedures and details. The intent is to define a rigorous liberal arts quantitative course that provides an important piece of a well-rounded general education, namely, building a student’s ability to reason quantitatively. The list of topics is meant to address this aim through a consistent core focus while still leaving time for additional math topics that can be relevant to a wide range of liberal arts and humanities areas; other topics that might be addressed include, but are not limited to:

- discrete math topics (for example, graph theory, scheduling, voting theory, game theory, fair division)
- geometry/trigonometry
- math in the arts (for example, Fibonacci numbers and the golden ratio)
- symbolic logic supporting probability

## Additional Clarification for the Math in Society Course Description

### Some Example Outcomes within the Core Topics

The following examples are intended to provide a clearer general sense of the level of performance expectations related to the broad core topics, not to define specific required outcomes. Where noted, the coding abbreviations in parentheses indicate a specific link between a particular example outcome and the broad course outcomes listed for the course: MR=mathematical reasoning; MH=mathematical habits of thought; MD=mathematical decision-making; MC=mathematical communication; and MS=mathematical symbols, techniques and computation.

#### Proportional Reasoning

*[Note: this core content area is often integrated into one or more of the other topics but can also be taught as a stand-alone topic.]*

- Use proportions and ratios to interpret quantities (e.g. per capita, per square mile, national debt as a percentage of GDP).
- Recognize and compare proportional relationships from verbal, graphical, symbolic and numerical scenarios and use these relationships to solve and analyze context-based problems. [MR]
- Apply proportionality to solve and analyze a variety of multi-step contextual problems (examples: similar triangles to determine the height of a tree, using percents to calculate taxes, recipe scaling, determining how many have a disease in a city if has a 1/2000 occurrence rate, working with map scales, balancing a chemical equation, Consumer Price Index, cost of living index, S&P 500, value of a dollar, scaling factors (area and volume), growth and form, etc.) [MS, MR]
- Estimate the relative size of quantities without calculation, utilizing intuition and reasonableness.

#### Personal Finance

- Use given formulas and perform relevant calculations pertaining to personal finance (e.g. the study of future value, present value, compound interest, annuities, financial loans) to solve context-based scenarios.
- Use multiple representations (algebraic, numeric, graphic, verbal) of mathematical models to interpret and analyze scenarios related to personal finance (future value, present value, compound interest, annuities, financial loans).
- Analyze and critique claims related to personal finance (future value, present value, compound interest, annuities, financial loans) to make informed decisions.

## Probability

- Calculate and interpret probabilities, including conditional probabilities, given contextual information contained in a two-way (contingency) table, and use these calculations to make informed decisions.
- Interpret percentages, fractions, and ratios as appropriate probabilities, including conditional probabilities, within an authentic context.
- Analyze and critique statements about probability and risk that appear in the media (including advertisements): e.g., risk and personal health decisions, false positives of medical tests, polls and other estimates of a population parameter, statements involving odds, etc.

## Descriptive Statistics

- Recognize and categorize methods of obtaining data (e.g. sampling, experimental, observational), discuss possible sources of bias, and use this information to make informed decisions.
- Use appropriate tools (e.g. spreadsheets, calculators) and strategies (e.g. verbal, numerical summaries, graphical summaries) to describe and display authentic data.
- Create, interpret, analyze, and critique graphical displays of data (e.g. boxplots, histograms, pie charts, and other more complicated displays which are typically found in the media).
- Calculate, interpret, analyze, and critique numerical summaries of data (including measures of center and spread).
- Compare and contrast two or more samples or populations by comparing numerical and graphical summaries of data.
- Write arguments properly using calculated statistics as supporting evidence [MH, MD, MC]
- Use, analyze, and critique statistical (e.g. regression) models derived from data.

## Growth Models

- Analyze data and/or scenarios to determine if they describe linear or exponential growth [MR]
- Identify growth rates, initial values, or point values expressed verbally, graphically, or numerically, and translate them into a format usable in calculation. [MR]
- Create linear and exponential models for an authentic situation.
- Use, interpret, and analyze linear and exponential models (including describing relevant features of the model, using the model to make predictions, discussing appropriateness and limitations of the model).



## Prerequisite Skills for Math &107 (Math in Society)

In order for students to be successful in a rigorous college level quantitative reasoning course it is essential that they have a firm foundation in basic number sense, the ability to reason algebraically, the ability to read and interpret graphs, and some initial exposure to probability and statistics. The following list of skills is intended to help frame our concept of a college-level quantitative reasoning course and to provide students and instructors with an understanding of the expectations we have for students who enroll in such a course. It is important to realize that students are not expected necessarily to achieve a high level of proficiency in all of these skills prior to entering Math &107 as many of these skills will continue to be developed and refined at the college level.

The Math&107 (Math in Society) description of skills and outcomes presumes that students entering the course have developed the mathematical skills and habits of mind to be successful in a college-level math class. That skill set includes those listed below; and may be documented through a suitable score on a placement test or achieved by successful completion of the appropriate pre-college level math sequence, to include an appropriate version of intermediate algebra.

*[Note: While many of these skills provide foundational support for multiple core topic areas in Math &107, the coding abbreviations in parentheses where noted suggest a primary link between a particular skill and one of the core content areas listed for the course: PR=proportional reasoning; PF=personal finance; P=probability; DS=descriptive statistics; and GM=growth models.]*

### Number Sense

- Use standard order of operations to evaluate expressions (including fractions and exponents)
- Calculate with, and convert between, decimals, fractions, and percents (PR, P)
- Interpret and use scientific notation (PR)
- Use various strategies to perform estimations (products, ratios, relative sizes) (PR)
- Use, and convert between, units (PR)
- Increase or decrease a given value by a given percentage (GM)
- Calculate the relative change (percent) between two quantities (P)

### Algebraic Reasoning and Modeling

- Use variables to represent quantities
- Solve linear equations and proportions (GM)
- Create and use linear models in a variety of authentic settings (GM)
- Interpret slope as a rate or ratio as appropriate for the given context (GM)
- Apply exponent rules to simplify expressions with exponents, including negative exponents (PF)
- Recognize and describe the relationship between variables expressed in an algebraic equation or graphical representation (intuitive notion of a function) (GM)
- Use, and convert between, different representations of relationships (verbal, algebraic, numerical, graphical)



### Graphical Sense

- Create and use simple graphs: lines, bar charts, pie charts, and histograms (DS)
- Read and interpret graphs, charts, and tables (DS)

### Statistical Literacy

- Calculate and interpret means and medians (DS)
- Interpret percents as probabilities or likelihoods (P)