Mathematical Decision Making for Life
Prerequisite: Secondary Mathematics II

Mathematical Decision Making is a four-quarter course for seniors. The course includes mathematical decision making in finance, modeling, probability and statistics, and making choices. The four quarters of instruction are independent of each other, allowing students to enter and exit the course quarterly. Students will make sense of authentic problems and persevere in solving them. They will reason abstractly and quantitatively while communicating mathematics to others. Students will use appropriate tools, including technology, to model mathematics. Students will use structure and regularity of reasoning to describe mathematical situations and solve problems.

Quarter A – Mathematical Decision Making: Finance

Standard I: Students will use mathematical analysis to manage personal resources and make financially sound decisions.

Objective 1: Determine, represent and analyze mathematical models for various types of income calculations.
   a. Compute and compare hourly wages, given commissions or salaries and hours worked.
   b. Compute gross earnings based on commissions, salaries, hourly wages, or piece-work.
   c. Compute net earnings after common payroll deductions.
   d. Research and compare annual earnings for various employment opportunities.

Objective 2: Create, represent, and justify personal budgets.
   a. Create spreadsheets, tables, and charts that represent personal income and expenses.
   b. Calculate the total costs of owning a car, including monthly payments, insurance, maintenance, and fuel.
   c. Analyze and model periodic monthly expenditures, including those that change during the year such, as heating and cooling costs.

Objective 3: Analyze mathematical models related to investing and borrowing money.
   a. Compute and compare the anticipated earnings for investments and savings plans.
   b. Interpret stock market data charts.
   c. Research and predict retirement income from savings, Social Security benefits, pensions, and investments.
   d. Compute the costs of loans for monthly payments.
   e. Compare time and costs required to borrow money compared to saving for purchase of an item.
   f. Analyze various types of loans to determine the best loan for a given situation.

Objective 4: Analyze numerical data to make quantitative and qualitative decisions.
   a. Research, compare, and contrast published ratios, rates, ratings, averages, weighted averages, and indices to make informed decisions.
   b. Use spreadsheets to manage large quantities of data.
   c. Understand and analyze situations involving large numbers, such as national debt or national budgets.

Mathematical Language and Symbols Students Should Use:
APR (fixed and variable), adjustments, annual fees, bi-weekly, capital gain/loss, compound interest, co-payment, deductible, deductions, FICA, future value, graduated, gross, index, interest, net, percent change, premium, principal, semi-monthly, stocks, weighted average, yield

Quarter B – Mathematical Decision Making: Modeling

Standard II: Students will use mathematical models to organize, communicate, and solve problems.

Objective 1: Use matrices to represent and analyze mathematical situations.
  a. Use matrices to represent and manipulate data.
  b. Multiply matrices by scalars to produce new matrices.
  c. Add, subtract, and multiply matrices of appropriate dimensions.
  d. Use matrices to represent geometric transformations.
  e. Use matrices to solve applied problems.

Objective 2: Model mathematical problems with geometric tools.
  a. Use geometric methods to solve design problems.
  b. Calculate measures of perimeter, surface area, area, and volume, and apply those measures to relevant situations.

Objective 3: Use mathematics to model and solve problems involving change.
  a. Analyze and solve problems involving models for linear, exponential, and logistic growth and decay.
  b. Identify, model, and solve problems involving cyclical change that can be represented using trigonometric functions.
  c. Identify, model, and solve problems involving change that can be represented with a piecewise function.
  d. Model and solve problems involving recursion or iteration.

Mathematical Language and Symbols Students Should Use:
amplitude, area, cyclical, exponential, iteration, linear, logistic, matrix, piecewise, perimeter, period, recursion, scalar, surface area, volume

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Quarter C – Mathematical Decision Making: Probability and Statistics

Standard III: Students will use statistics and probability to make decisions.

Objective 1: Understand and communicate statistical information.
   a. Report results of statistical studies in both oral and written form, including graphical representations.
   b. Describe strengths and weaknesses of sampling techniques, data and graphical displays, and interpretations of summary statistics.
   c. Identify uses and misuses of statistical analyses.

Objective 2: Develop and evaluate inferences and predictions that are based on data.
   a. Understand and evaluate random processes underlying statistical experiments.
   b. Determine possible sources of statistical bias and describe the potential impact of such bias on a study.
   c. Make inferences and justify conclusions from sample surveys, experiments, and observational studies.
   d. Use data from a sample survey to estimate a population mean or proportion.

Objective 3: Apply statistical methods to design and conduct a survey or an experiment.
   a. Formulate a question that can be analyzed using statistical methods.
   b. Determine possible sources of variability of data, including both those that can and cannot be controlled.
   c. Identify the population of interest, select an appropriate sampling technique, and collect data.
   d. Create graphical displays of data.
   e. Calculate and compare measures of central tendency, spread, and unusual features in data.

Objective 4: Use the rules of probability to calculate independent and conditional probabilities in real contexts.
   a. Distinguish between subjective, experimental, and theoretical probability.
   b. Calculate probabilities using addition and multiplication rules, tree diagrams, and two-way tables using correct probability notation.
   c. Calculate conditional probabilities of compound events using two-way tables and Venn diagrams.
   d. Use permutations and combinations to find probabilities.

Objective 5: Analyze risk and return in the context of everyday situations.
   a. Construct and analyze tree diagrams, Venn diagrams, and area models to make decisions in problem situations.
   b. Construct and interpret two-way frequency tables of data.
   c. Weigh the possible outcomes of a decision by assigning probabilities to payoff values and finding expected values.
   d. Use probabilities to make fair decisions.
   e. Analyze decisions and strategies using probability concepts.

Mathematical Language and Symbols Students Should Use:
bias, combination, conditional, expected value, experiment, experimental probability, fair decision, frequency table, independent, measures of central tendency (mean, median, mode), measures of spread (range, standard deviation), observational study, permutation, randomization, sample, survey, theoretical probability, tree diagram, variability, Venn diagram

Quarter D - Mathematical Decision Making: Using Models to Make Choices

Standard IV: Students will use mathematical models to analyze situations and make choices.

Objective 1: Construct viable arguments and critique the reasoning of others.
   a. Use stated assumptions, definitions, and previously established results to construct an argument.
   b. Make conjectures and build a logical progression of statements to explore the truth of conjectures.
   c. Recognize and use counterexamples.
   d. Justify and communicate conclusions, and respond to the arguments of others.
   e. Compare two plausible arguments and make decisions based on correct logic.

Objective 2: Analyze and evaluate the mathematics behind various ranking and selection methods.
   a. Analyze and apply various ranking algorithms to determine an appropriate method for a given situation.
   b. Evaluate various voting and selection processes to determine an appropriate method for a given situation.
   c. Analyze and apply various algorithms for making fair divisions.

Objective 3: Construct, analyze, and interpret flow charts.
   a. Construct flowcharts to describe processes or problem-solving procedures.
   b. Analyze flowcharts and follow procedures to solve problems.
   c. Evaluate efficiency of control processes.
   d. List requirements and restrictions needed for a suggested algorithm.

Objective 4: Use a variety of graphical models to represent network and scheduling problems.
   a. Solve scheduling problems using mathematical models.
   b. Explore shortest route and fastest route situations.
   c. Solve precedence or critical paths problems to facilitate "what if" scenarios.

Mathematical Language and Symbols Students Should Use:
algorithm, counterexample, critical paths, Euler path, flow chart, logic, minimal spanning trees, truth table, vertex-edge graph