

Course Description: *Math Modeling* is a course in which students will explore key mathematical concepts through real-world problem-solving. The course is divided into two semesters. Semester A focuses on data, research, and financial decision-making. Through this work, students will learn about and complete application tasks that involve data analysis, probability, and research design, equipping students with the knowledge and skills to carry out and evaluate research conclusions. Semester A also involves income and banking, investing and insurance, and credit and loans, with an emphasis on applying mathematical reasoning to everyday financial situations. Through this work, students will build quantitative literacy and critical thinking skills relevant to both academic and personal contexts.

Module	Lesson Title	Objectives
Module 1: Data Analysis	1.1 Displaying Data	- Organize data using a frequency table. - Create line graphs, circle graphs, and bar graphs. - Interpret data using line graphs, circle graphs, and bar graphs.
	1.2 Central Tendency	- Calculate the mean, median and mode given a data set. - Choose the appropriate measure of center for a data set.
	1.3 Variability	- Calculate the IQR of a dataset. - Calculate the range of a dataset. - Calculate the standard deviation of a data set using technology. - Choose the appropriate measure of spread for a data set.
	1.4 Histograms and More	- Create a dot plot from a data set. - Create a histogram from a data set. - Create a stem-and-leaf plot from a data set. - Interpret these displays in context of data.
	1.5 Box-and-Whisker Plots	- Calculate the five number summary. - Create a box-and-whisker plot from a data set. - Interpret a box-and-whisker plot in context.
	1.6 Making Predictions	- Read a statistical table or graph. - Make predictions about what may happen using tables and graphs. - Determine if predictions are reasonable based on the data.

Module	Lesson Title	Objectives
	1.7 Scatterplots	- Sketch a scatterplot. - Interpret a scenario using a scatterplot of it. - Identify positively and negatively correlated data using a scatterplot.
	1.8 Comparing Predictions	- Compare sets of data using scatter plots and box-and-whisker plots. - Make predictions about compared data trends. - Determine if predictions are reasonable based on the data trends.
Module 2: Probability	2.1 Probability	- Compare sets of data using scatter plots and box-and-whisker plots. - Make predictions about compared data trends. - Determine if predictions are reasonable based on the data trends.
	2.2 Independent Events	- Explain the difference between independent and dependent events. - Identify dependent and independent events. - Determine the probability of the second of two events.
	2.3 “Or” Events	- Define an "or" event. - Calculate "or" probability when the events are mutually exclusive. - Calculate the "or" probability when the events are not mutually exclusive.
	2.4 “And” Events	- Define an "and" event. - Calculate the "and" probability when the events are independent. - Calculate the "and" probability when the events are dependent.
	2.5 Calculating Outcomes	- Explain the fundamental counting principle. - Calculate outcomes using the fundamental counting principle. - Calculate a factorial. - Differentiate between when to use factorials and when to use the fundamental counting principle.
	2.6 Permutations	- Represent a permutation using mathematical notation. - Calculate the number of outcomes using permutation. - Calculate probability using permutation.
	2.7 Combinations	- Represent a combination using mathematical notation. - Distinguish between scenarios appropriate for permutation and those for combination.

Module	Lesson Title	Objectives
		- Calculate the number of outcomes using combination. - Calculate probability using combination.
	2.8 Empirical Probability	- Distinguish between theoretical probability and empirical probability. - Compare empirical results to theoretical expectations. - Determine if a theoretical claim is reasonable based on empirical results.
Module 3: Research Design	3.1 Types of Research	- Explain how to construct a quality research question. - Define surveys, experiments, and observational studies. - Select the most appropriate form of research for a particular scenario. - Describe the key factors necessary for designing a quality research study.
	3.2 Data Collection	- Explain how to minimize bias during data collection. - Define a <i>research population</i>. - Explain how to create data collection tools. - Describe how to collect data for a given scenario.
	3.3 Types of Models	- Define normal, geometric, and binomial distributions. - Select the most appropriate form of research for a particular scenario. - Use experiments to determine the reasonableness of binomial and geometric theoretical models.
	3.4 Means	- Distinguish between a population mean and a sample mean. - Calculate a sample mean. - Calculate the standard deviation and standard error of a sample.
	3.5 Proportions	- Distinguish between a population mean and a sample mean. - Calculate a sample mean. - Calculate the standard deviation and standard error of a sample.
	3.6 Means vs. Proportions	- Distinguish when to calculate means or proportions to answer research questions. - Analyze research data using the most appropriate method.

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	3.7 Drawing Conclusions	- Describe the process for drawing reasonable conclusions from data. - Draw valid conclusions from real-world graphs and statistics. - Analyze graphs and statistics to determine the validity of stated or implied conclusions.
	3.8 Presenting Data	- Explain the different ways to present data. - Identify the main components of a research presentation. - Evaluate the quality of research presentations.
Module 4: Income & Banking	4.1 The Basics of Budgets	- Differentiate between a fixed expense and a variable expense. - Develop a budget. - Read linear graphs representing income, expenses, and bank account balances. - Analyze budgets to determine if there is enough income to meet expenses.
	4.2 Types of Income	- Explain gross income, net income, discretionary income, and disposable income. - Distinguish between discretionary income and disposable income. - Calculate different types of income. - Compare incomes for growth and opportunity.
	4.3 Compensation	- Explain the different types of compensation an employee may receive beyond a fixed income. - Develop a mathematical model to determine gross compensation. - Evaluate a compensation package and determine if it is fair.
	4.4 Taxes	- Explain the different types of taxes US citizens may pay. - Calculate the amount of payroll or personal tax owed. - Calculate the rate of taxes paid.
	4.5 Financial Institutions	- Distinguish between banks, credit unions, and online banks. - Name advantages and disadvantages of using each type of financial institution. - Determine which type of financial institution is appropriate given a real life scenario.
	4.6 Account Types	- Explain the different types of accounts you can open at a financial institution. - Recognize the fees that may be associated with different types of accounts. - Make decisions about what type of account is appropriate for a given situation.

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	4.7 Interest	- Differentiate between simple interest and compound interest. - Calculate the interest rate earned by an account - Distinguish between saving and investing. - Identify situations that are appropriate for saving and investing.
	4.8 Recordkeeping	- Identify the different types of records to keep. - State how long to keep certain types of records. - Read a bank statement. - Explain how to contest incorrect records.
Module 5: Invest & Insure	5.1 Bonds	- Define what a bond is. - Explain the different types of bonds available. - Explain the difference between bonds and certificate of deposits (CDs). - Calculate the rate of return on a bond.
	5.2 Stocks	- Define what stock is. - Compare buying stocks to buying bonds or CDs. - Calculate investment returns.
	5.3 Mutual Funds and Annuities	- Define mutual fund and annuity. - Explain the risks involved with investing in a mutual fund or an annuity. - Calculate returns on investments in a mutual fund or an annuity. - Compare investing in a mutual fund or an annuity to CDs, bonds, or stocks.
	5.4 Retirement	- Explain the different retirement plans available and their risks. - Compare different investments to determine which is best for a given scenario. - Calculate the amount of money you can reasonably save for retirement. - Determine the amount of money needed to be invested to reach a specific retirement goal.
	5.5 Risk Management	- Explain the types of unavoidable financial risks people face. - Identify unavoidable risk management strategies and methods. - Explain the types of avoidable investment risks. - Explain investor protections and responsibilities to safeguard against investment risks.

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	5.6 Auto Insurance	- Explain why individuals and families need auto insurance. - Explain the different auto insurance coverage options. - Calculate the cost of auto insurance. - Compare auto insurance plans to determine which one to purchase.
	5.7 Home Insurance	- Explain why individuals and families need renter's or homeowner's insurance. - Explain what is covered in an insurance claim. - Describe how the cost of renter's and homeowner's insurance is determined. - Calculate the cost of homeowner's or renter's insurance.
	5.8 Other Types of Insurance	- Explain why individuals and families need health, disability, and life insurance. Calculate the financial responsibility of the insured based on health insurance coverage. - Determine the best health insurance plan to meet healthcare needs.
Module 6: Credit and Loans	6.1 Fixed & Variable Interest	- Explain the difference between fixed and variable interest rates. - Calculate the amount of interest paid on a fixed-interest loan. - Calculate the amount of interest paid on a variable-interest loan. - Compare loan terms to choose the best option for a given scenario.
	6.2 Credit	- Explain what credit is. - Compare the advantages and disadvantages of different types of credit. - Determine the best credit plan for a scenario. - Explain how to protect personal credit.
	6.3 Credit Cards	- Describe the benefits and risks associated with using a credit card. - Decide which credit card is best for a given scenario. - Calculate the amount of interest to be paid on credit card balances.
	6.4 Loans	- Explain the different types of loans available. - Calculate debt-to-income ratio. - Calculate the total cost of a loan.
	6.5 Amortization	- Define amortization. - Read an amortization table for a loan. - Create an amortization table for a loan.

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		• Apply an amortization table to a real-world context.
	6.6 Mortgages	• Explain what a mortgage is. • Describe the costs associated with mortgages. • Estimate a monthly mortgage payment. • Create an amortization table for a mortgage.
	6.7 Financing a Car	• Explain what a car loan is. • Determine budgeted car expenses. • Estimate a monthly car payment. • Create an amortization table for a car loan.
	6.8 Buying vs. Renting	• Explain the difference between buying a renting. • Compare buying a home to renting a home or apartment. • Compare buying a car to leasing a car. • Choose the best option, buying or renting (leasing) for a given scenario.