Santa Rosa City Schools
Office of Educational Services
2025-2026 New Course Proposal

(Must be submitted to the Office of Educational Services)

Course Title: Financial Math P

School: Santa Rosa City Schools Department: Mathematics Grade Level(s): 11,12 Credits: 10

Graduation Requirement Area		A-G Admission Requirement (HS only)
Mathematics	AND	Mathematics (c)

Length of Course:

- ☑ year
- ☐ semester

Course Designations: *Check all other designations that apply.*

☐ Career Technical Education ☐ Proposition 98 Arts	☐ Advanced Placement (AP) ☐ International Baccalaureate (IB)

Attach a response to the following issues, referring to the standards (where applicable) and frame-work for this course's subject area. Incomplete proposals will be returned. Be sure to include the appropriate item number and title (if an attachment is being provided).

Needs Assessment Statement: Provide a rationale with specific evidence to support this course's inclusion in SRCS' Course Catalog.

During the last 2 years, the UC Board of Admissions and Relations with Schools (BOARS) has clarified its expectations for third year math courses requiring Algebra 2 or Math 3 content beginning with the 2026-27 school year.

In prior years, SRCS has offered 3 courses as alternatives to Math 3. Two of those courses are statistics based and are no longer eligible to be counted as a Math 3 alternative for the UC/CSU system moving into the next school year. The Math Steering Committee determined that it is in SRCS students' best interest to continue to offer a Math 3 alternative that will qualify for UC/CSU Math 3 requirements.

The current course offering and textbook, Math with Financial Implications, does fully reflect the Math 3 content standards.

This updated course proposal and textbook align with UC-approved Math 3 financial courses, as well as the Math 3 content standards. As a result the Math Steering Committee determined that this updated course was appropriate to meet the UC requirements.

Is this course modeled after an approved A-G Course on the UC Portal?

- ☑ Yes : District and course:_________________________ (can add the link)
- ☐ No

Prerequisites: List the prerequisites that must be met for entrance into the course (*must be aligned with district policy relating to prerequisites) Note: Honors courses must have a prerequisite AND a co-requisite (a co-requisite = a non-honors option)*

Integrated Math 2P

Course Overview: Provide a one- to two-paragraph description of the course, including learning objectives, description of units.

Financial Math is a mathematical modeling course that is algebra-based, applications-oriented, and utilizes technology where appropriate. The course addresses college preparatory mathematics topics from Advanced Algebra, Statistics, Probability, Pre-calculus, and Calculus under eleven financial umbrellas: discretionary expenses, banking, credit, automobile ownership, employment, income taxes, independent living, the Stock Market, starting a business, retirement planning, and budgeting. The course allows students to experience the interrelatedness of mathematical topics, find patterns, make conjectures, and extrapolate from known situations to unknown situations. The mathematics topics contained in this course are introduced, developed, and applied in the financial settings covered. Students use a variety of problem-solving skills and strategies in real-world contexts and question outcomes, using mathematical analysis and data to develop their understanding. During the course, students will construct, question, model, and interpret financial situations through symbolic, graphical, geometric, and verbal representations. It provides students an experience-centered financial context for understanding and applying the mathematics they will use in the future, and is aligned with the recommendations of the Common Core State Standards, as stated in this excerpt: "...An array of challenging options will keep math relevant for students, and give them a new set of tools for their futures..." Furthermore, the New California Mathematics Framework reinforces that "when students are engaged in meaningful, investigative experiences, they can come to view mathematics, and their own relationship to mathematics, far more positively."

Course Materials: Provide the text book and/or other materials to be used in the course. Include: Title, Author, Edition/Year and Publisher for textbooks and literary texts; provide Article Title, Author, Date, and URL if applicable for scholarly articles, primary documents, periodicals, etc.

Financial Algebra, Gerver and Sgroi, 3e/2026, Cengage (primary)

Next Gen Personal Finance Financial Algebra year-long course (supplementary)
https://www.ngpf.org/math/financial-algebra/

Detailed Course Design

Please organize your course by units and emphasize how the learning aligns with the course criteria for the subject area. For each unit, include 5-7 sentences describing the learning goals, topics and skills covered as well as a 5-7 sentence description of at least one representative assignment students complete in the unit.

Unit 1: Discretionary Expenses

In this unit, students will use statistics to describe trends in the context of discretionary expenses. This unit is very engaging and creates a strong entry-point for examining financial decisions, as most students' current financial concerns are discretionary. Additionally, this unit prioritizes statistics, an identified need for all California mathematics students by the CA Math Framework. Students will gain experience with a wide variety of statistics, including but not limited to bimodal data, frequency distribution, normal curve, correlation coefficient and z-scores.
Activity: The Spending Snapshot

Example lesson:

Financial Context: Analyzing a "Mystery Month" of bank statements to predict annual discretionary spending and the likelihood of staying under budget.

1. The Setup: The "Cup" of Data
Students are given a "Transaction Jar." This contains 100 small slips of paper, each representing a single discretionary purchase made by a fictional character over the last year.
The Population: The jar contains an unknown distribution of four expense categories:

1. Dining & Drinks (e.g., Coffee, Takeout)
2. Entertainment (e.g., Movies, Concerts, Gaming)
3. Shopping (e.g., Clothes, Gadgets)
4. Misc. "Whims" (e.g., Impulse buys at the checkout line)

2. The Experiment: Random Sampling
Students perform the same mathematical process as the candy activity:

- Draw with Replacement: Pull one slip, record the category, and put it back.
- The Sample Size: Repeat this 100 times.
- The Record: Use a tally sheet to track the frequency of each category.

3. The Math: Relative Frequency Table
Students calculate the Empirical Probability for each category based on their sample.

4. The Prediction: Population Estimation
Students are told that the "Transaction Jar" (the population) actually contains 500 total transactions from the past year. Using their relative frequencies, they must predict the total number of times the character spent money in each category.

5. Financial Analysis & Budgeting
To bridge the gap between math and financial literacy, students complete the following:

- Weighting the Costs: If the average "Dining" transaction is $15 and the average "Shopping" transaction is $60, which category is the bigger threat to the character's savings, even if the frequency is lower?
- Risk Assessment: If the character only budgets for 150 "Dining" transactions a year, but the relative frequency predicts 210, what is the probability that they will overspend in any given month?
- The "Replacement" Discussion: In finance, "sampling with replacement" mimics a person who has consistent habits. If the character changes their habits (e.g., deletes a delivery app), how does the "population" in the jar change for the next year?

Reflection Question
Once students reveal the actual contents of the jar, discuss Sampling Error:
"If your prediction was off by 10%, how would that impact a real-life bank account? Is it safer to over-predict or under-predict your discretionary expenses when building a budget?"

Unit 2: Banking Services

In this unit, students use exponential and logarithmic functions to compute compound interest and compare it to simple interest. They derive formulas and use iteration to compute compound interest. While learning exponential and logarithmic forms and properties, they apply their understanding to short-term, long-term, single deposit and periodic deposit accounts.

Example Lesson:

The Time Value of Money
Topic: Exponential Growth and Logarithmic Solving for Financial Horizons.

1. The Power of Frequency (Exponential Growth)
In banking, interest can be compounded at different intervals (monthly, daily, or hourly). As the

number of compounding periods approaches infinity, we transition from discrete growth to continuous compounding.

The Activity:
Students compare two High-Yield Savings Accounts (HYSA).

- Bank A: Offers 5% interest compounded monthly.
- Bank B: Offers 4.95% interest compounded continuously.

Challenge: If a student deposits $5,000, which bank yields more after 5 years? Students must set up the equations to see if the higher frequency of Bank B can overcome the higher rate of Bank A.

2. Solving for the Unknown: When Will I Be a Millionaire?
The most common question in banking is not "How much will I have?" but "How long will it take?" To solve for t when it is in the exponent, students must use Natural Logarithms.
The Scenario:
A client deposits $25,000 into an investment account with a steady 8% annual return, compounded continuously. They want to know exactly when their balance will hit $1,000,000.

3. The "Cost of Minimums" (Logarithmic Decay in Debt)
Banks often set minimum payments on credit cards to be a small percentage of the balance. Students will use logarithms to calculate how long it takes to pay off a $5,000 debt if they only pay the minimum.
The Activity:
A credit card has a 24% APR ($r = 0.02$ per month) and a balance of $5,000.

- Scenario A: The student pays $150/month.
- Scenario B: The student increases the payment to $250/month.

Students calculate the value of n for both scenarios. They will observe how a linear increase in payment (M) results in a logarithmic (non-linear) decrease in the time (n) spent in debt.

<u>**Unit 3: Consumer Credit**</u>

This unit provides students with a comprehensive understanding of credit basics and loan fundamentals empowering students to make informed decisions regarding credit and borrowing habits. Additionally students will explore mathematical concepts essential for mathematical modeling including functions, compound interest, exponential growth, and regression. Students learn how to use mathematics to make wise credit choices that fit their needs, current financial situation, and future goals.

Example Lesson:

The Anatomy of a Credit Balance
Goal: To use a variety of parent functions to model different phases of credit card usage and repayment.

1. The Linear Phase: Consistent Spending
Function: $f(x) = mx + b$
Early in the month, a user might use their card for a daily, fixed expense—like a $5 commute.

- The Model: $L(t) = 5t + 200$
- The Context: The balance grows at a constant rate. The slope ($m=5$) represents the daily discretionary cost, and the y-intercept ($b=200$) is the carry-over balance from the previous month.

2. The Quadratic Phase: The "Acceleration" of a Shopping Spree
Function: $f(x) = ax^2 + bx + c$
Sometimes spending isn't constant; it accelerates (e.g., during holiday shopping). As the user buys bigger gifts or shops more frequently, the "rate of spending" increases.

- The Model: $Q(t) = 2tt^2 + 10t + 500$
- The Context: The t^2 term shows that the spending is accelerating. The "velocity" of debt is increasing every day.

3. The Cubic Phase: The Splurge and Course-Correction
Function: $f(x) = ax^3 + bx^2 + cx + d$
A cubic function can model a "wave" of behavior. Imagine a user who splurges (rising curve), feels "buyer's remorse" and stops spending (the plateau), but then yields to a new temptation (the final rise).

- The Model: $C(t) = 0.5(t-5)^3 + 1000$
- The Context: This describes a fluctuating balance that has an inflection point—a moment where the "spending momentum" changes direction or intensity.

4. The Exponential Phase: The Cost of Interest
Function: $f(x) = ab^x$
This is the most dangerous phase. If a user stops spending but only makes the minimum payment, the interest charges on the remaining balance grow exponentially.

- The Model: $E(t) = P(1 + r)^t$
- The Context: If r is the monthly interest rate (e.g., 2%), the balance P grows compounded over t months.

5. The Logarithmic Phase: The "Long Tail" of Repayment
Function: $f(x) = a \ln(x) + c$ OR Solving for t
In banking, we use logarithms to determine how long it takes to pay down a balance. If you pay a fixed amount (M) each month, the way your balance P drops is non-linear.

- The Model: $t = [\ln(M) - \ln(M - rP)] / \ln(1+r)$

The Context: Logarithms show us the "diminishing returns" of small payments. It reveals why the last $500 of a debt often feels like it takes longer to pay off than the first $500.

Unit 4: Automobile Ownership

Various functions, their graphs, and data analysis can be instrumental in the responsible purchase and operation of an automobile. In this unit, students will examine the mathematics of automobile advertising, sales and purchases, insurance, depreciation, safe driving, and accident reconstruction. This unit spans a wide variety of mathematics topics including geometry, probability, piecewise functions, systems of linear equations, and square root functions.

Example Lesson:

The Automotive Equity Audit
Project Goal: To construct and analyze a system of competing functions—one linear (Cumulative Cost) and one non-linear (Asset Value)—to identify the "Breakeven Horizon" and the mathematical impact of discretionary financial choices.

Phase 1: The Cumulative Cost Model C(t)In this phase, students model the total cash outflow required to secure and maintain the vehicle. This is represented as a linear growth function.

Phase 2: The Triple-Model Depreciation Study V(t)
Students will investigate three distinct mathematical ways to model the decline of an asset's value (V).

A. Straight-Line Depreciation (Linear)
Assumes a constant dollar loss per month.

B. Exponential Decay (The Industry Standard)
Assumes the car loses a fixed percentage of its remaining value monthly.

C. The "Bathtub" Curve (Regression Analysis)
Historical data often shows high initial depreciation, a stable middle period, and a sharp decline as maintenance costs spike.

Phase 3: Systems Analysis & The "Equity Gap"
By graphing C(t) and V(t) on the same axes, students visualize the battle between their investment and the asset's worth.

1. Solving the Non-Linear System: Students find the intersection point (t_c) where C(t) = V(t). Since this often involves a transcendental equation (linear = exponential), students will use a graphing utility's "Intersect" tool or Newton's Method to find the solution.

The Negative Equity Window: * Define the domain where C(t) > V(t). In finance, this is known as being "Underwater." * Students must shade this region and calculate the Vertical Distance between the functions at t = 24 and t = 48 to determine how much "negative equity" exists at those specific milestones.

Phase 4: Discretionary Variable Stress Test
Students must perform a Transformation Analysis to see how changing one discretionary variable alters the "Equity Horizon."

- The Down Payment Shift: If the student increases their down payment (d) by 25%, how does the vertical shift of the cost line affect the intersection point?

The Interest Rate Impact: If a lower credit score increases the APR (r), how does the resulting change in the slope (M) affect the duration of the "Underwater" window?

Unit 5: Employment Basics
Students examine the working world, beginning with hiring processes, compensation, benefits, and early employment decisions that relate to retirement. Students are exposed to data regarding the diversity of employment opportunities in the United States workforce, key labor laws, and other employment-related aspects of society. Mathematical topics include but are not limited to: arithmetic and geometric sequences, literal equations and expressions, and domain.

Example Lesson:

We shift our focus from the base salary to the total compensation package. This includes employer-matched retirement contributions, health savings accounts (HSAs), and stock-based incentives.
This activity, "The Total Rewards Simulation," helps students evaluate which benefit structure builds the most wealth over a career.

Assignment: The Total Rewards Simulation
Objective: To model the growth of employer-provided benefits using sequence formulas and to determine the future value of a "benefits-rich" compensation package.

Part 1: The Arithmetic Benefit (The HSA Contribution)
Scenario: Company A offers a "Wellness Incentive." Every year, they deposit a fixed $1,200 into your Health Savings Account (HSA) to help cover your deductible. You decide to let this money sit in a non-interest-bearing cash account.

1. Define the Sequence: Write the explicit formula for the total amount in the HSA at the *start* of year n.
2. $a_n = a_1 + (n-1)d$
3. Year 15 Forecast: If you never spend a dime of this money, how much will be in the account at the beginning of Year 15?
4. The Accumulation: Use the arithmetic series formula to find the total value of all contributions made over a 30-year career.
5. $S_n = (n/2)(a_1 + a_n)$

Part 2: The Geometric Benefit (The 401(k) Match)
Scenario: Company B offers a retirement match. They contribute $3,000 in Year 1. Because your salary and their contribution percentage are tied to growth, their annual contribution increases by 4% each year.

1. Define the Sequence: Write the explicit formula for the employer's contribution in year n. $a_n = a_1 \cdot r^{(n-1)}$
2. The Common Ratio: Identify r. (Hint: 1.04).
3. The Comparison: At what year n does the single annual contribution from the 401(k) match (Company B) surpass the single annual contribution of the HSA (Company A)?
4. The Accumulation (Total Value): Use the geometric series formula to calculate the total amount the employer has contributed to your retirement after 30 years.

$S_n = a_1 [(1 - r^n) / (1 - r)]$

Part 3: The Equity "Cliff" (Geometric Mean)
Scenario: Some companies offer Stock Options that "vest" over time. You are told your total stock value at the end of Year 1 was $2,000. By the end of Year 3, due to the company's growth, it was worth $4,500.

1. Finding the Middle: If the value of these benefits grew geometrically, use the Geometric Mean to find the value at the end of Year 2.
   $Value_2 = \sqrt{(V_1 \cdot V_3)}$
2. The Real-World Logic: Why is the geometric mean a more accurate representation of stock growth than an arithmetic average (mean) of the two values?

Part 4: Discretionary Analysis (The "Benefit Trade-off")
In the professional world, you often have to choose between a higher salary or better benefits. Perform the following algebraic "Stress Test":

- The "Cash Out" Strategy: If Company A offers you an extra $2,500 in cash per year instead of the HSA and 401(k) benefits, write a linear function $f(x) = 2500x$ to represent that extra cash over x years.
- The Intersection: Compare this linear cash function to the Geometric Series from Part 2. At what point does the "Benefit Value" outweigh the "Extra Cash"?
- The Verdict: Many employees make the *discretionary* choice to take a higher salary today. Based on your geometric series calculation, what is the "opportunity cost" of that choice over a 30-year career?

Reflection: The "hidden" Math of Employment

- The Power of n: In a geometric sequence, the most dramatic growth happens in the final years. How does this encourage "employee retention" (staying at one company longer)?
- Arithmetic Stability: Why might a younger employee prefer an arithmetic benefit (like a flat HSA contribution) while an older employee might prefer a geometric one (like a percentage-based 401(k) match)?

Follow-up Question:
If you had to choose between a benefit that added a flat $5,000 to your net worth every year or one that started at $2,000 but grew by 6% annually, at which year in your career would you want to switch from the first option to the second?

<u>Unit 6: Income Taxes</u>

In this chapter students use IRS tax tables, schedules, and worksheets, as well as discover the equations and piecewise functions upon which the progressive tax system is based. Students examine tax forms both through algebraic symbols and graphic representations. Lessons inform students about the types of taxes that are levied and the categories of taxpayers who pay them to build their understanding of the US tax system.

This lesson transitions students from "checking the table" to "understanding the engine" by converting the IRS tax structure into a series of piecewise-defined linear functions. This approach allows advanced algebra students to see how the US progressive tax system is mathematically constructed.

Example Lesson:

The Algebra of the IRS

Goal: To translate the IRS Tax Rate Schedule into a continuous piecewise function and identify the "Marginal vs. Effective" tax rates using linear equations.

1. The Context: What is Progressive Taxation?
The US uses a Progressive Tax System, meaning the "next dollar" you earn is taxed at a higher rate than the "first dollar." This creates a sequence of tax brackets.
Discretionary Insight: Taxes are the ultimate non-discretionary expense, but understanding the math allows individuals to make discretionary choices about 401(k) contributions or tax-deferred

investments to lower their "taxable income" (the x-variable).

2. The Data: 2024 Tax Schedule (Single Filers)
Students start with a standard IRS Schedule.

3. The Mathematics: Building the Piecewise Function
Students must convert the table into a formal piecewise function, T(x), where x represents taxable income.
Activity: Finding the "Hidden" Slope-Intercept Form
Students are asked to distribute the percentages and simplify each "piece" into $y = mx + b$ format.

4. Graphic Representation: The "Kinked" Line
Students graph T(x) on a coordinate plane.

- Visualizing the Brackets: Students observe that the graph is continuous (there are no jumps) but not smooth.
- Slope Analysis: The slope of each segment represents the Marginal Tax Rate. As x increases, the line becomes steeper at each "kink" (the boundary values).

5. Advanced Analysis: Marginal vs. Effective Rate
This is where students often have a "lightbulb" moment regarding financial misinformation. Many people fear "moving into a higher bracket" because they think their *entire* income will be taxed at the new rate.
The Task:

1. Calculate Marginal Tax: If Alex earns $50,000, what is their marginal rate? (Answer: 22%).
2. Calculate Effective Tax Rate: Use the function to find the total tax T(50,000).
    - T(50,000) = 5,426 + 0.22(50,000 - 47,150) = 6,053.
3. The Ratio: Calculate the Effective Rate: T(x)/x = 6,053/50,000 approx 12.1%.

The Synthesis: Students graph the Effective Tax Rate Function, E(x) = T(x)/x. They will discover this is a Rational Function that approaches the marginal rate as an asymptote but never actually reaches it.

6. Reflection: Tax Strategy

- Algebraic Shift: If the government gives a $2,000 standard deduction, does that represent a horizontal shift or a vertical shift of the tax function?
- Discretionary Impact: If you contribute $5,000 of your "discretionary income" to a traditional IRA (which reduces your taxable income x), how much do you actually "save" in taxes if you are in the 22% bracket versus the 12% bracket?

How does the visual of the "Effective Rate" asymptote change your perspective on how much of a raise is "lost" to taxes as you earn more?

Unit 7: Independent Living

In this unit, students work their way through the mathematics that models moving, renting, and purchasing a place to live. They also explore the geometric demands of floor plans and design, and discover the relationship between area and probability. In addition to a variety of more advanced geometry topics, students also explore trigonometry and deepen their understanding of the use of exponential and linear equations and systems.

Example Lesson:

This activity challenges students to apply Geometric Modeling and Optimization to the financial realities of homeownership. Instead of just calculating area, students will explore the relationship between architectural constraints and the "hidden costs" of home maintenance.

Activity Title: The Equity Architect
Goal: To use coordinate geometry, area-volume relationships, and linear modeling to evaluate the long-term maintenance costs of a residential floor plan.

Phase 1: Floor Plan Analytics (Coordinate Geometry)
Students are provided with a blueprint of a 1,200 sq. ft. starter home mapped onto a coordinate plane

where 1 unit = 1 foot.
The Tasks:

- Polygon Modeling: Students must define the rooms as a series of vertices. For non-rectangular rooms (e.g., an L-shaped kitchen or a bay window), students use the Shoelace Formula or composite area addition to find the exact square footage.
- Area = $1/2\ |(x_1y_2 + x_2y_3 + \ldots + x_ny_1) - (y_1x_2 + y_2x_3 + \ldots + y_nx_1)|$
- Distance & Perimeter: Calculate the total linear footage of the exterior walls using the distance formula $d = \sqrt{(x_2-x_1)^2 + (y_2-y_1)^2}$ to estimate the cost of siding or insulation.

Phase 2: The "Efficiency Ratio" (Surface Area vs. Volume)
Independent living requires managing utility bills. Students investigate how the Surface Area to Volume Ratio (SA:V) impacts heating and cooling costs.
The Challenge:
Compare two living room designs with the same floor area (e.g., 400 sq. ft.):

1. Design A: A standard 20' x 20' room with 8' ceilings.
2. Design B: A "Great Room" with 18' vaulted ceilings.

Mathematical Analysis:

- Calculate the volume (V) of air that needs to be climate-controlled.
- Calculate the total surface area (SA) of the walls/ceiling where heat transfer occurs.
- The Synthesis: If heat loss is proportional to SA, and cooling cost is proportional to V, students must write a function C(h) where cost is a function of ceiling height, and determine the "discretionary cost" of aesthetic height versus monthly utility savings.

Phase 3: Home Improvement & Optimization
Students simulate a common home improvement project: Re-flooring and Crown Molding.

- Waste Factor (Rational Functions): In real-world maintenance, you cannot buy the exact amount of material needed. Flooring is sold in boxes of 22 sq. ft. Students create a function B(f) to determine the number of boxes needed:
- $B(f) = [A (1 + w)] / 22$
- *(Where A is area and w is the "waste factor" percentage).*
- Optimization: Given a fixed discretionary budget of $2,500, students must use their geometric data to decide between "High-End Flooring in the Bedroom" vs. "Mid-Range Flooring throughout the whole house." They must justify their choice using the ratio of Value Added per Square Foot.

Phase 4: Exterior Maintenance (Scaling & Rate of Change)
The roof of the home is a series of triangular prisms.

- Pitch & Slope: Students calculate the "pitch" of the roof as a slope (m).
- The Shingle Problem: Using the Pythagorean Theorem, students find the "slant height" of the roof to calculate the total surface area for shingle replacement.
- Linear Projection: If the roof lasts 20 years and costs $12,000 to replace, students must determine the "Geometric Sinking Fund"—how much must be saved monthly ($y = mx$) starting at Year 1 to ensure the cash is available at Year 20?

Reflection: The "hidden" Geometry of Finance

- The Perimeter Trap: Why does a long, narrow house cost more to heat and paint than a square house with the same square footage?
- Discretionary Trade-offs: If a vaulted ceiling (Design B) increases your heating bill by 15% but increases the resale value of the home by 5%, at what year does the cost of the "aesthetic" outweigh the financial gain?

How would you prioritize your home maintenance budget: by the rooms with the largest area, or the rooms with the highest "usage frequency" per square foot?

Unit 8: The Stock Market

Students are introduced to basic business organization terminology in order to read, interpret, chart and algebraically model stock ownership and transaction data. Through graphs, spreadsheets, proportional reasoning and regression, students learn to analyze the inherent risks and rewards associated with investment through the Stock Market.

Example Lesson:

This task, "The Momentum Trader's Audit," moves beyond basic stock tracking to explore the mathematical signals used by professional analysts: Simple Moving Averages (SMA) and Linear Regression Trends.

Students will analyze why "discretionary" trading based on gut feeling often fails compared to the mathematical "smoothing" of volatile data.

Task: The Momentum Trader's Audit

Objective: To analyze stock market volatility using moving averages and linear regression to identify "Buy/Sell" signals and predict future price points.

Part 1: Proportional Reasoning & The "Price-to-Earnings" (P/E) Ratio
Before looking at price movement, analysts look at value proportionality. The P/E ratio is the ratio of a company's share price (S) to its earnings per share (E).

1. The Proportion: If Company Alpha has a share price of $150 and annual earnings of $6.00 per share, calculate its P/E ratio.
2. The Comparison: Company Beta has a P/E ratio of 18. If its earnings are $4.50 per share, what is its current share price?
3. The Analysis: If the industry average P/E is 20, which stock is mathematically "undervalued" relative to its earnings?

Part 2: Moving Averages (The "Smoothing" Effect)
Stock prices are "noisy" (volatile). To find the true trend, traders use a Simple Moving Average (SMA). An n-day SMA is the arithmetic mean of the closing prices over the last n days.

Data Set (Last 10 Days of Closing Prices for "TECH"):

$d = {102, 105, 103, 108, 110, 107, 112, 115, 114, 120}

1. Calculate a 3-Day Moving Average: Create a new sequence M where each term M_t is the average of days {t-2, t-1, t}.
   - *Example:* $M_3 = (102+105+1030) / 3 = 103.33$
2. Graphing the "Lag": Plot the raw daily prices and the 3-day SMA on the same coordinate plane.
3. Interpretation: How does the SMA curve differ from the raw price curve? In terms of Transformations, why does the SMA appear to "lag" behind the actual price peaks?

Part 3: The "Golden Cross" (Systems of Averages)
Traders often look for the intersection of a Short-Term SMA and a Long-Term SMA.

- The Scenario: * Fast-Moving Average: $F(t) = 0.8t + 100$
  - Slow-Moving Average: $S(t) = 0.3t + 115$
- The Task: Solve the system of linear equations to find the month (t) where the Fast-Moving Average crosses above the Slow-Moving Average.
- The Signal: In finance, this intersection is called a "Golden Cross." Algebraically, why is the "Fast" average (the one with the steeper slope) considered a more sensitive indicator of recent momentum than the "Slow" average?

Part 4: Linear Regression & The "Best Fit" Trend
Using a graphing utility, enter the 10-day data set from Part 2 (x = day, y = price).

1. Perform Linear Regression: Find the equation of the least-squares regression line $\hat{y} = mx + b$.

2. Correlation Coefficient (r): Identify the value of r. What does this value tell you about the strength of the stock's upward momentum?
3. Extrapolation: Use your regression equation to predict the price of "TECH" on Day 30.
4. Critical Thinking: Why is a linear model for a stock price inherently risky for long-term predictions (e.g., Day 365)? What "discretionary" real-world events could cause the r value to plummet suddenly?

Reflection: Math vs. Emotion

- Averages: If a stock's current price is \$120 but its 200-day moving average is \$90, what does that tell you about the "proportional" risk of buying the stock today?
- Regression: If the slope (m) of your regression line is positive, but the last three data points are below the line, is the "momentum" increasing or decreasing?

Follow-up Question:

If you had to choose between a stock with a high r value (steady, predictable growth) and a stock with a high *m* slope but a low r value (volatile, rapid growth), which mathematical indicator would better align with your personal risk tolerance?

<u>Unit 9: Mathematically Modeling a Business Start-Up</u>
In this unit, students will model a real-life business situation using mathematics topics. Students will use their understanding of a variety of features of different types of functions to look ahead, predict, and calculate while weighing all options to make sound business decisions. Through this context students will consider a variety of mathematics including but not limited to an in-depth analysis of linear and quadratic functions as well as systems.

Example Lesson:

"The Startup Sweet Spot," places students in the role of a business consultant analyzing a company's financial health. Students will discover that profit in business is rarely linear; as you produce more, costs and market saturation change, creating a path that can be modeled perfectly by a Quadratic Function.

Task: The Startup Sweet Spot

Objective: To model a business's monthly profit using a quadratic function, and to locate and interpret key characteristics—such as the vertex, axis of symmetry, x-intercepts, and y-intercept—in a real-world commercial context.

The Scenario

You are launching a company that manufactures custom eco-friendly water bottles.

- If you charge too much, nobody buys them.
- If you charge too little, you can't cover your production costs.

After conducting market research, your financial analyst determines that your Monthly Profit (P), measured in thousands of dollars, depends directly on the Number of Bottles Sold (x), measured in thousands of units. The relationship is modeled by the function:

$P(x) = -2x^2 + 16x - 24$
Part 1: The Initial Investment (The y-intercept)

Before you sell a single water bottle, your business has fixed costs (rent, machinery, insurance).

1. Calculate the y-intercept: Find P(0).
2. Business Interpretation: What does this specific coordinate (0, P(0)) mean for your business? Why is the value negative, and what does it tell you about a discretionary choice like "starting a business with zero sales"?

Part 2: The Breakeven Points (The x-intercepts)

To keep your business afloat, you need to know your "Breakeven Points"—the production volumes where your profit is exactly 0.

1. Algebraic Extraction: Set P(x) = 0 and solve for x by factoring, completing the square, or using the Quadratic Formula.

2. Business Interpretation: You will find two values for x.
   - What is the significance of the *lower* x-intercept?
   - What is the significance of the *higher* x-intercept? (Hint: Why does profit drop back to zero if you try to manufacture and force too many items into the market?)

Part 3: Maximizing Profit (The Vertex)

Every business owner wants to maximize their efficiency. The peak of your profit curve is represented by the Vertex of the parabola.

1. Find the Axis of Symmetry: Use the formula x = -b/(2a) to find the production level that balances your business perfectly.
2. Find the Maximum Profit: Substitute your axis of symmetry value back into P(x) to find the coordinates of the vertex (h, k).
3. Business Interpretation: Complete this statement for your executive board:
   "To achieve our maximum possible monthly profit of [Amount], our factory must produce exactly [Amount] water bottles per month."

Part 4: Domain and Risk Analysis

In pure mathematics, the domain of a quadratic function is all real numbers. In business, you are constrained by physical and financial realities.

1. The "Profitable Domain": Look at your graph. For what interval of x is P(x) > 0? This is your company's "Safe Operating Zone."
2. The Discretionary Pivot: Suppose a competitor enters the market, causing a Vertical Shift downward by 4 units (P(x) - 4).
   - Write the new profit equation.
   - Use the discriminant to determine if it is still mathematically possible for your business to make a profit.

Reflection: Math vs. Intuition

- Concavity: Why must the leading coefficient (a) of a realistic business profit model be *negative* (a < 0)? What would happen to the market if profit could grow upward infinitely like a positive parabola?
- Diminishing Returns: If you are currently operating at a production level *past* your vertex, what discretionary operational decisions should you make to return your company to the "Sweet Spot"?

Follow-up Question:

If you had to choose between a business model with a very high, narrow vertex (huge maximum profit potential, but a tiny profitable domain) or one with a lower, wide vertex (lower maximum profit, but a vast profitable domain), which quadratic profile better matches your personal risk tolerance as an entrepreneur?

<u>Unit 10: Planning for Retirement</u>

This unit emphasizes that planning for retirement is something that should begin early, despite the fact that retirement is years away. Students learn decisions they can make as they begin their working lives that will support financial security for their retirement years. Students will use exponential equations, probability, measures of central tendency and other math topics, while they explore retirement vocabulary and formulas.

Example Lesson:

"The Retirement Runway," puts students in the shoes of a financial planner helping a client navigate the uncertainties of long-term wealth building. Students will combine the predictability of Exponential Growth with the real-world variability of Probability and Central Tendency to determine if a retirement strategy will succeed.

Task: The Retirement Runway

Objective: To model wealth accumulation using exponential functions, analyze historical market variations using measures of central tendency, and evaluate the mathematical probability of outliving a retirement nest egg.

Part 1: The Base Plan (Exponential Growth)

Your client, a 25-year-old software engineer, makes a discretionary choice to invest $5,000 into a retirement account today and vows to let it compound untouched for 40 years until they turn 65.

The Model: Assuming an average annual return of 8%, write an exponential function A(t) to model the growth of this initial investment over time t (in years).
$A(t)=P(1+r)t$

The 40-Year Horizon: Compute A(40). How much will that single $5,000 investment be worth at retirement?

The Rate Transformation: If inflation averages 3% over those 40 years, your "real" purchasing power rate is $8\%-3\%=5\%$. Write a revised exponential function R(t) using this inflation-adjusted rate and calculate R(40).

Analysis: How does a seemingly small 3% drop in the growth factor affect the final output over 40 years?

Part 2: Analyzing Market Volatility (Central Tendency)

The stock market never returns a flat 8% every single year. It fluctuates. Below is a 7-year sample of historical annual returns from a retirement fund:

$Returns=\{+18\%,-5\%,+12\%,+22\%,-2\%,+6\%,+5\%\}$

Calculate Central Tendency: Find the mean, median, and mode of this data set.

The Outlier Impact: Suppose the fund experiences a massive "market crash" year with a return of −30%, changing the data set to an 8-year sample.

Recalculate the mean and median.

Which measure of central tendency was impacted more by the crash?

Why is the median often considered a more "grounded" metric for a retiree to look at when budgeting their multi-year strategy?

Part 3: The Sustainability Window (Probability)

Once your client reaches age 65, they stop accumulating wealth and start withdrawing it. They have a total nest egg of $1,000,000. Their discretionary lifestyle requires a withdrawal of $60,000 per year.

An actuarial life expectancy table provides the probability distribution for how many years a 65-year-old individual is expected to live post-retirement.

"Flat-Cash" Horizon: If the $1,000,000 sits in a cash vault earning 0% interest, calculate exactly how many years it will take to deplete the fund to 0.

Calculating Risk Probability: Based on your answer above, use the table to find the probability that your client will outlive their money.
Risk=P(Living longer than the depletion year)

The Continuous Mitigation: If the client leaves the money in a conservative account earning 4% interest while withdrawing $60,000 a year, the timeline shifts. We can approximate their balance using the sequence:
$B_n = 1.04(B_{n-1} - 60{,}000)$
If this investment extends their account's lifespan to 32 years, how does that change the probability of financial failure?

Reflection: Managing the Horizon

Exponential Power: Why does starting to invest at age 25 yield drastically different mathematical results than starting at age 35, even if you save the exact same amount of money per month?

Probabilistic Reality: Why must financial advisors look at the "worst-case scenario" probabilities rather than just trusting the average (mean) market returns when planning for a retiree?

Follow-up Question: If you had to choose between a retirement portfolio with a high average return but high volatility (unpredictable swings) or a lower average return with zero volatility (guaranteed steady growth), which mathematical profile would you select for the accumulation phase (ages 25–65) versus the withdrawal phase (ages 65+)?

Unit 11: Prepare a Budget

Students are asked to call upon the knowledge acquired in all of the preceding units in order to create and chart a responsible personal budget plan, to mathematically analyze cash flow, and to determine net worth. In doing so, students will consider typical home bills, organize and track expenses, manage balancing income and debt, and examine budgets from an annual, semiannual, quarterly, monthly, and weekly perspective.

Example Lesson:

"The Matrix Budget Project," frames students as financial analysts who need to manage multiple income streams and changing discretionary expenses across multiple months.

Students will use Matrices to organize data and perform scaling operations, alongside System Graphing to determine when a budget model transitions from a deficit to a surplus.

Assignment: The Matrix Budget Project

Objective: To organize multi-category discretionary budgets using algebraic matrices, apply scalar operations to simulate economic shifts, and graph systems of equations to identify personal savings milestones.

Part 1: Organizing the Budget (Matrix Construction)

Imagine you are budgeting for a household with two roommates (Alex and Jordan). You track three main categories of discretionary spending across two months (January and February).

- January Discretionary Spending:

- Alex: Spent $150 on Dining, $80 on Entertainment, $120 on Shopping.
- Jordan: Spent $110 on Dining, $140 on Entertainment, $95 on Shopping.

- February Discretionary Spending:
  - Alex: Spent $130 on Dining, $95 on Entertainment, $85 on Shopping.
  - Jordan: Spent $120 on Dining, $110 on Entertainment, $150 on Shopping.

The Task:

1. Construct a 2 x 3 matrix, J, representing January spending, where rows represent the person (Row 1 = Alex, Row 2 = Jordan) and columns represent the category (Col 1 = Dining, Col 2 = Entertainment, Col 3 = Shopping).
2. Construct a 2 x 3 matrix, F, representing February spending using the same dimensions.
3. Matrix Addition: Compute T = J + F. What does the resulting matrix T represent in the context of their joint household budget?

Part 2: Simulating Lifestyle Creep (Scalar Multiplication)

"Lifestyle creep" happens when a discretionary budget expands due to a change in habits or inflation. Suppose both roommates make a discretionary choice to loosen their restrictions, resulting in a 15% increase across all spending categories for the upcoming spring months.

1. The Scalar Operation: Define a scalar factor k that represents a 15% increase.
2. Compute $k \cdot T$: Multiply the total winter budget matrix T by your scalar k.
3. Financial Interpretation: Look at entry $a_{2,3}$ in your new matrix. Exactly how much cash is Jordan projected to spend on shopping after this lifestyle expansion?

Part 3: The Savings Runway (System Graphing)

Now we shift from tracking expenses to analyzing net savings over time.

Alex and Jordan decide to open two different styles of automated savings accounts to hold their leftover discretionary cash.

- Account A (Alex's Strategy): Starts with an initial deposit of $200 from a tax refund and grows steadily by adding $40 per month from unspent discretionary funds.
- Account B (Jordan's Strategy): Starts with $0, but Jordan uses a high-yield savings sweep that adds $65 per month from their paycheck.

The Task:

1. Write the System: Create two linear functions, A(m) and B(m), mapping total savings as a function of the number of months (m).
2. Graph the System: Plot both linear equations on the same coordinate grid. Label the y-intercepts and carefully scale your axes.
3. Find the Intersection: Use algebraic substitution or graphing techniques to find the exact coordinate (m, y) where A(m) = B(m).

Part 4: Domain & Inequality Analysis

A budget is only effective if you understand its limits. Use your graph from Part 3 to analyze the following intervals:

- Domain $0 \le m < m_{intersection}$: Which roommate has accumulated more wealth? Write this statement as an inequality using your function names.
- Domain $m > m_{intersection}$: Jordan's line surpasses Alex's line. Even though Jordan started with zero cash, explain how the rate of change (the slope) dictates the long-term reality of the graph.

Reflection: Strategic Allocations

- Matrix Structure: Why are matrices a more efficient tool for a commercial accountant or software app to track multi-category spending than a simple list of linear equations?

- Graphing Reality: If Alex wants to shift the intersection point m so that Jordan *never* catches up, what discretionary changes could Alex make to either the y-intercept or the slope of line A(m)?

Follow-up Question:

If you had to track a third roommate's budget across four distinct categories (Dining, Entertainment, Shopping, and Travel) over a 6-month period, what would be the exact dimensions (rows x columns) of the matrix stack required to handle that data?

Future Expansion Program Needs: What problems would be encountered in replicating this course at another school

If this course were offered at additional schools, the purchase of additional textbooks would likely be needed, dependent on student course requests district-wide.

ADVANCED, HONORS, ADVANCED PLACEMENT, or INTERNATIONAL BACCALAUREATE: This item must be completed, if the course is identified with the distinction of Advanced, Honors, AP, or IB. (i.e. how does this course exceed the requirements of a college preparatory course of its kind?)

Describe the end-of-course assessment

CAREER PATHWAY COURSES: Please identify the industry certification that students will be preparing to take or describe the culminating experience for the pathway that students will be completing as part of the coursework.

Assurances			
Does the textbook, other curricular materials, and proposed course meet District-adopted content and performance standards and State curriculum frameworks?	☑ Yes	☐ No	☐ N/A
Will the scope and sequence of this course adequately prepare students to pass the exit or end-of-course exam?	☑ Yes	☐ No	☐ N/A

Budget figures must be included even if they are an estimate.

Projected Costs	**Start-up**	**Ongoing**

Personnel (Not to include classroom instructor unless a new section is needed)		
Instructional Material Supplies per student (textbooks, software, etc.)	$140 x 330 students	
Services (training, equipment maintenance, contracts, etc.)		
Capital Outlay (remodeling, technology, etc.)		
Total Projected Costs	$55,919.70	

Instructional Materials- must include estimates for new materials even if none have been selected. Place in chart above.

Type	Publisher	Title ISBN Author	Copyright	# Have/Need
primary	Cengage	Financial Algebra, 979-8-214-07608-9, Gerver et. al.	2026	0/330

Funding Source(s) for Costs and Instructional Materials

Grants (indicate specific grant and grant timeline)	
Categorical Funds (include related programs)	
Career Technical Education (must be for an approved CTE course)	
Department Funds	
Other (be specific)	Secondary lottery funds

Appendix of Additional Documents

**** Required additional documents include meeting minutes where the course was discussed and approved***
Math Steering Committee Minutes 11/7/24 Math Steering Committee Minutes 4/23/26

Financial Algebra (Cengage) Textbook Pilot Committee Minutes 12/4/25

Signatures:
Originator ______________________________ Date ____________
Dept. Chair/Team Leader ______________________________ Date ____________
Principal ______________________________ Date ____________

______ Route to Executive Director

District Department Chair Review and Approvals:
Steering Committee Director: ______________________________

Department Chair Name	Signature	Site	Approved / Not Approved
Wendy Valle	Wendy Valle	PHS	Approved
Eric J. Bohn	[signature]	SRHS	Approved
Kim Itzkov	[signature]	RHS	Approved
Brittney Geddes	B Geddes	MCHS	Approved
Petra Huffman	Petra Huffman	MHS	Approved
Brendan Johnson	Brendan Johnson	EAHS	approved

District Principal Review and Approvals:

Principal's Name	Signature	Site	Approved / Not Approved
[signature]	Andrea Correa	PHS	Approved
Kimberly Clissold	[signature]	SRHS	Approved
Donna Garibaldi	[signature]	RHS	Approval
Angy Wiere	Angy Wiere	MCHS	Approved
April Santos	[signature]	MUSH	Approved.
Casey Cunningham	[signature]	EAHS	Approved

District Office Use Only

District Office:
Asst. Supt.,(or Designee) Educational Services ______________________________ Date____________

Transcript Course ID	Transcript Short Title	Course Title	Default Credits
MH034P	Fin Math P	Financial Math P	5
Course Length	**State Course Code**	**UC/CSU Requirement**	**CTE Pathway**
Semester	9254	Math area C	No

Graduation Requirements	Information and Evaluation Department Review
M/Z	