ADVANCED FUNCTION STANDARDS

The DoDEA high school mathematics program is built on courses which are grounded by rigorous standards. The process and content of standards for mathematics courses offered in DoDEA schools prepares students to become *College and Career Ready* upon graduation. The traditional course sequence begins with Algebra 1 and culminates with Advanced Placement courses in Calculus and Statistics. In addition, a series of student interest courses provide students with elective options.

Vision: DoDEA students will become mathematically literate world citizens empowered with the necessary skills to prosper in our changing world. DoDEA educators' extensive content knowledge and skillful use of effective instructional practices will create a learning community committed to success for all. Through collaboration, communication, and innovation within a standards-driven, rigorous mathematics curriculum, DoDEA students will reach their maximum potential.

Guiding Principals

Standards:
- Clear and concise standards provide specific content for the design and delivery of instruction.
- Standards provide details that ensure rigor, consistency, and high expectation for all students.
- Standards identify the criteria for the selection of materials/resources and are the basis for summative assessment.

Instruction:
- The curriculum focuses on developing mathematical proficiency for all students.
- The instructional program includes opportunities for students to build mathematical power and balances procedural understanding with conceptual understanding.
- Effective teachers are well versed in mathematical content knowledge and instructional strategies.
- Classroom environments reflect high expectations for student achievement and actively engage students throughout the learning process.
- Technology is meaningfully integrated throughout instruction and assists students in achieving/exceeding the standards.

Assessment/Accountability
- Assessment practices provide feedback to guide instruction and ascertain the degree to which learning targets are mastered.
- Assessments are used to make instructional decisions in support of the standards and measure standards-based student performance.
- All teachers of mathematics and administrators providing curriculum leadership should be held accountable for a cohesive, consistent, and standards-based instructional program that leads to high student achievement.

Mathematics Process Standards

The DoDEA PK-12 mathematics program includes the process standards: problem solving, reasoning and proof, communication, connections, and representation. Instruction in mathematics must focus on process standards in conjunction with all PK-12 content standards throughout the grade levels

Problem Solving	Reasoning and Proof	Communication	Connections	Representation
Instructional programs from Pre-Kindergarten through Grade 12 should enable all students to:	Instructional programs from Pre-Kindergarten through Grade 12 should enable all students to:	Instructional programs from Pre-Kindergarten through Grade 12 should enable all students to:	Instructional programs from Pre-Kindergarten through Grade 12 should enable all students to:	Instructional programs from Pre-Kindergarten through Grade 12 should enable all students to:
• build new mathematical knowledge through problem solving; • solve problems that arise in mathematics and in other contexts; • apply and adapt a variety of appropriate strategies to solve problems; • monitor and reflect on the process of mathematical problem solving.	• recognize reasoning and proof as fundamental aspects of mathematics; • make and investigate mathematical conjectures; • develop and evaluate mathematical arguments and proofs; • select and use various types of reasoning and methods of proof.	• organize and consolidate their mathematical thinking through communication; • communicate their mathematical thinking coherently and clearly to peers, teachers, and others; • analyze and evaluate the mathematical thinking and strategies of others; • use the language of mathematics to express mathematical ideas precisely.	• recognize and use connections among mathematical ideas; • understand how mathematical ideas interconnect and build on one another to produce a coherent whole; • recognize and apply mathematics in contexts outside of mathematics.	• create and use representations to organize, record, and communicate mathematical ideas; • select, apply, and translate among mathematical representations to solve problems; • use representations to model and interpret physical, social, and mathematical phenomena.

Financial Literacy Standards
Guidance and Commentary

Our Vision:

This course is designed to help students make connections between Algebra, Geometry and real world applications to Finance. Students should be actively engaged in their learning as they build conceptual understanding of algebraic and geometric representations of Financial Mathematics. Further, students should recognize that modeling the real world could be complicated; there is not always one right answer, but a range of acceptable solutions.

The expectation is that students will routinely explore financial problems using graphing calculators and on-line financial resources. Students should become proficient in knowing where to find and how to use the appropriate resource that best supports their needs. Student's ability to estimate and look for reasonable solutions to problems is a critical skill in ascertaining the validity and reliability of computer and calculator resources.

Strand:	**FL.1**	**REASONING WITH EQUATIONS**

FL.1.1 **Reason quantitatively and use units to understand, solve and explain problems in finance. Choose and interpret units consistently across formulas, tables and graphs.**

EXAMPLE: You plan to open a savings account with a $7,000 deposit at a bank closest to your home. The bank offers you two accounts with the same nominal interest rate of 4%. One account has interest compounded and credited semi-annually. The other account has interest compounded and credited monthly. Model these situations algebraically and graphically. Determine which account will give the highest return on your investment based on the annual percentage yield (APY). When comparing investment products, why does the APY matter?

FL.1.2 **Create, understand and explain tabular and graphical models representing financial problems and describe the relationship between variables or numbers.**

EXAMPLE: To buy a computer, Tom borrowed $3000 at 9% simple interest. If he will be making monthly payments for four years, calculate:

      (a) total amount of interest to be paid,
      (b) the total amount (interest and principal) to be paid back,
      (c) the monthly payment amount.

Create an amortization table and graph to represent the loan scenario above and explain the relationship between any two of the variables. i.e. Is the relationship between interest paid and the term of the loan proportional? Is there a linear or exponential relationship? If principal increases what happens to total amount of interest paid? If Tom asks for more time to repay the loan, what happens to the total interest paid? If Tom puts $1000 down and finances $2000, what happens to the monthly payment and/or total interest paid?

FL.1.3   **Explain and justify the viability or reasonableness of solution(s) in context of a real world financial problem.**

EXAMPLE: You have identified the car you would like to buy, which costs $8000. You can afford payments of $250 per month. You can either borrow the money at 10% simple interest (compounded monthly) and buy the car now, or invest $250 at 6% simple interest (compounded monthly) and pay cash for the car later. How long will it take to pay for the car each way?   Assume an inflation rate of 2% meaning if you wait to purchase the car it will go up in price 2% annually.   Justify what you would do and why.

FL1.4   **Understand and explain how changes in the coefficients in an equation or expression affect the possible solution set in context of a financial problem.**

EXAMPLE: Your aunt bought a car two years ago for $18,700 and now she wants to sell it. She knows that the value of similar models has been depreciating at a average rate of 10% per year. Explain how she can estimate the value of her car at the time that she sells it. Write an algebraic equation representing an estimated value of her car at any point in time T that she chooses to sell it.

How does the value of the vehicle change if the depreciation rate averages 20% per year? How does the algebraic equation change representing a depreciation rate of 20% per year?

Strand: FL.2   LINEAR AND EXPONENTIAL RELATIONSHIPS

FL.2.1   **Analyze a relationship between two variables in a financial problem to determine if it meets the criteria of a function.   Identify independent and dependent variables, the domain, range, and roots.**

EXAMPLE: In Jacksonville, Florida, the value of a home in 2003 was $339,000.   The value of the homes in Jacksonville have declined at an average rate of 6.5% per year. Create a table and graph representing the value of the home for each year from 2003 to 2010.   If depreciation rates continue at 6.5%, estimate the value of the home from for each year from 2011 to 2015.

This home was purchased in 1989 for $200,000. If homes in Jacksonville continue to depreciate at the 6.5% rate, when will this home be worth less than the purchase price?

What did you identify as the dependent and independent variables in your graph?   Is this a function?

FL.2.2   **Understand and use the properties of exponents as they relate to growth models for a single deposit or an amortization table for a loan.**

EXAMPLE: A college student finances a computer that costs $2250.   The financing plan states that as long as a minimum monthly payment of 2.25% of the remaining balance is made the student does not have to pay interest for 24 months.   The student makes only the minimum monthly payments until the last payment.   Determine the amount of the last payment if the student buys the computer without paying interest.

FL.2.3   **Create and analyze linear functions and inequalities using graphs, tables, and equations representing real world problems in Finance.**

EXAMPLE: A money manager is considering investing in two types of bonds, Bond *A* and Bond *C*.   Bond *A* pays an annual yield of 8.5% and Bond *C* pays 12%.

The manager can invest up to $100,000 in these bonds, but because C is riskier than the other, the manager will limit the investment in C to 40% of the total.   Furthermore, the manager will invest a total of at least $60,000 in the bonds.   Translate the constraints in the problem into a system of inequalities.   Then determine how much the manager should invest in each in order to maximize the return on the investment.
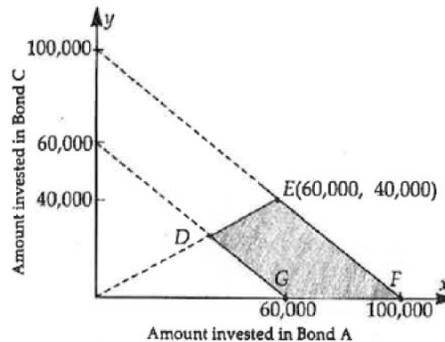
FL.2.4   **Model, interpret and solve problems in finance using a system of linear equations or inequalities; represent the solutions algebraically, graphically and with a table of values.**

EXAMPLE: Larry is refinancing his mortgage.   His new interest rate is 4.25%.   He has the option to buy down that interest rate to 4.125% by paying 1 point (1 percent).   Create an algebraic, graphical and tabular model representing Larry's two mortgage options and explain under what circumstances each would be the best choice for Larry.

When graphed as a system of equations, explain what the point of intersection represents in terms of Larry's decision.

FL.2.5   **Recognize and explain properties of a graph and table of values to justify the solution of a financial problem.   Make connections between the two representational models in identifying the solution set.**

EXAMPLE: Nancy has saved $5400. She would like to earn $250 per year by investing her money. She received advice about two different investments: a low-risk investment that pays a 5% annual interest and a high-risk investment that pays a 9% annual interest. Model this situation algebraically and graphically to determine how much Nancy should invest in each type of investment to reach her goal. How would you advise Nancy to invest her money and why?

FL.2.6   **Make predictions for a set of financial data based on a linear or exponential relationship and determine reasonableness.**

You have an opportunity to invest $400.00.   The expected yearly cash flows are (-400, 100, 150, 200).   Given an interest rate of 5.5%, provide justification to the worthiness of this investment.

**Strand:**   **FL.3**   **DESCRIPTIVE STATISTICS**

FL.3.1   **Make comparisons, predictions, and inferences, using information displayed in frequency distributions; box-and-whisker plots; scatterplots; line, bar, circle, and picture graphs; and histograms.**

EXAMPLE: The bar graph below shows the average student loan debt, average credit card debt, and combined debt from a student credit card study.   If this trend continues, what can you predict about student loan debt if a student decides to go to graduate school immediately after obtaining their undergraduate degree?
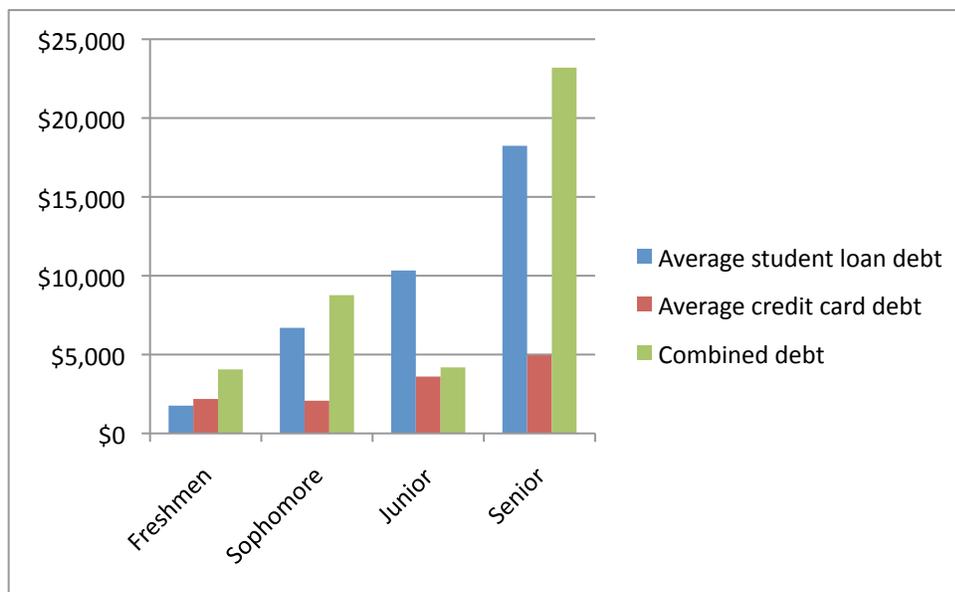
FL.3.2   **Use appropriate statistical analysis techniques to formulate and answer related mathematical questions to solve a financial problem.**
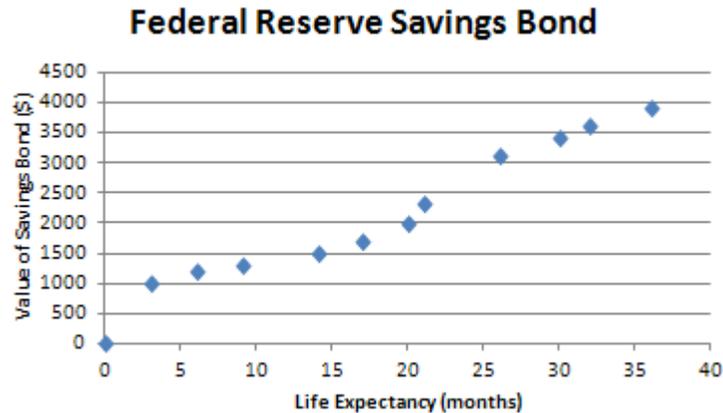
EXAMPLE:

The boxplots below show prices of used cars (in thousands of dollars) advertised for sale at three different car dealers.
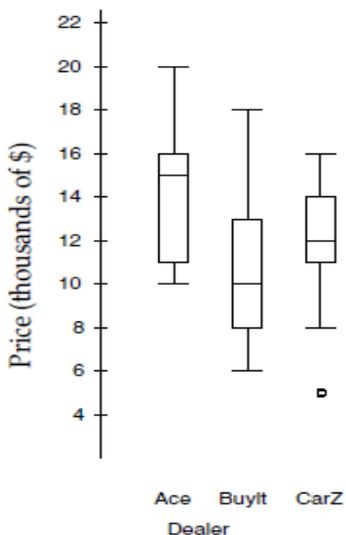
- Which dealer offers the cheapest car and at what price?
- Which dealer has the lowest median price,
- and how much is it?
- Which dealer has the smallest price range, and what is it?
- Which dealer's prices have the smallest IQR, and what is it?
- Which dealer generally sells cars cheapest? Explain.

FL.3.3   **Represent data with two quantitative variables on a scatter plot and describe how the variables are related. Understand and use the concept of line of best fit or regression models.**

EXAMPLE: The scatterplot below represents the value of a savings bond over time (or the life expectancy of that bond).   Use the concept of line of best fit to describe how the variables are related.   What is the approximate value of the Savings Bond at full maturity (36 months).

Federal Reserve Savings Bond

FL.3.4   **Interpret and explain the rate of change (slope) and the y-intercept of a linear or exponential model in the context of a financial problem.**

EXAMPLE: The graph below shows the ups and downs of the S & P 500 stock price index from 1963 to 1993.   Interpret and explain the rate of change and y-intercept.

Standard and Poor's 500 Stock Price Index

Year

FL.3.5   **Using technology, compute and interpret the correlation coefficient of a linear fit in context of a financial problem.**

EXAMPLE: The correlation between *Fuel Efficiency* (as measured by miles per gallon) and *Price* of 150 cars at a large dealership is r = - 0.34.   Explain whether or not each of these possible conclusions is justified:

- The more you pay, the lower the fuel efficiency of your car will be.
- The form of the relationship between Fuel Efficiency and Price is moderately straight.
- There are several outliers that explain the low correlation.
- If we measure Fuel Efficiency in kilometers per liter instead of miles per gallon, the correlation will increase.

FL.3.6 **Analyze data representing a financial problem and determine if linear or exponential functions appropriately models the data.**

EXAMPLE: The table shows the numbers of business and non-business users of instant messaging for the year 2004-2010. Explain whether a linear or exponential function best models the relationship between the business and non-business users and why.

Years since 2004	1	2	3	4	5	6	7
Business users (in millions)	1	2	5	7	20	40	80
Non-business user (in millions)	55	97	140	160	195	235	260

Strand: FL.4 EXPRESSIONS AND EQUATIONS

FL.4.1 **Identify and interpret key characteristics of linear, exponential, step and piece-wise functions in context of a financial situation (domain and range, roots, intercepts, intervals of increase and decrease and rate of change).**

EXAMPLE: Assuming the rate of inflation is 3% per year, the predicted price of an item can be modeled by the function $P(t) = P_0(1.03)^t$, where P_0 represents the initial price of the item and *t* is in years. Graph this equation and identify the type of function, domain and range, and rate of change.

FL.4.2 **Model and solve financial problems using linear, exponential, step, or piece-wise functions; represent the problems using tables, graphs and algorithms.**

EXAMPLE: Taylor has been saving her allowance and her babysitting money for years. She and her friend are planning to travel to Paris, France, when they have each saved enough money. Taylor has saved **$6,500** so far and her friend has saved almost as much. Taylor wants her money to work as hard for her as she has worked to save it!

Taylor's bank has three types of investments to choose from, if she wants to put her money to work: **annual certificates of deposit** with a **3.5% APR**, **statement savings accounts** with a **3.25% APR**, and **money market savings accounts** with a **3.0% APR**.

Given that Taylor and her friend have at least one more year before the big trip, which investment will help Taylor the most?   Why?

FL.4.3 **Identify variables and use algebraic equations for compound interest, simple interest and the rule of 72 to solve financial problems.**

EXAMPLE: You have **$8,250** to invest and you won't need the money until five years from now. You decide you will put the money into a **bank account compounding monthly** for that period of time. If your goal is to have **$10,000** when the investment matures, what **APR** do you need to achieve your goal?

A =
P =
r =
n =
t =