Honors Finite Math/Brief Calculus Course Description

Honors Finite Math / Brief Calculus is a year-long Desert Vista High School class which corresponds to the material in two semester-long courses at Rio Salado: MAT217 Finite Math for Business Analysis and MAT212 Brief Calculus.

1st semester – Finite Mathematics

There are three general sections of the course which cover the following units and material:

1) Optimization Problems: The first section's goal is for students to learn how to use mathematics to solve problems making optimum choices (maximizing profit, minimizing cost, etc.) Much of this section is review (equations of lines, solving systems of equations, solving systems of inequalities in 2-variables using graphing, and after reviewing these foundations, the course emphasizes the ability to translate real-world situations into systems which can be solved, and then presents the Simplex Method for solving linear programming optimization problems in more than 2 variables. The specific units in this section of the course are:

- **Unit 1: Lines** (equations of lines, graphing lines, using lines to model real-world situations, parallel/perpendicular lines, applications of lines such as breakeven for profit-loss, economic market supply-demand equilibrium, 'mixture' problems, and distribution system problems.)
- **Unit 2: Systems of equations** (graphical meaning of system solution in 2, 3 dimensions, review of system solution procedures: graphical, substitution, elimination, Gaussian elimination, Gauss-Jordan elimination, review of augmented matrix representation of systems, solutions via row operations (mainly using a calculator/RREF), single-, no-, and many-solutions cases, numerically and in context of word problems, creating systems of equations to represent word problem scenarios, matrix operations including matrix multiplication, the use of matrix addition, subtraction, and multiplication to solve application problems, matrix inverse and solution of matrix equations.
- **Unit 3: Systems of linear inequalities** (graphing inequalities, and solution of systems of inequalities with 2-variables as overlapped shaded region, creating systems of inequalities to represent the constraints of word problems scenarios, objective functions and optimization using linear-programming (graphical) for 2D systems.
- **Unit 4: The Simplex Method** (creating Simplex Tableaus to represent word problem scenarios, using Simplex method for optimization for maximization and minimization problems with mixed constraints with 3 or more variables – all using a calculator Pivot program).

2) Probability and Statistics: The second section is focused on developing an in-depth understanding of probability and how it informs decisions in real-world situation, and then proceeds to examine ways of representing data graphically and exploring the foundations of statistics. Specific units in this section of the course are:

- **Unit 5: Sets and Combinatorics** (set notations and operations, Venn diagrams, DeMorgan's properties, enumeration of sets, counting formula (OR), using Venn

diagrams to handle overlap with word problems, the multiplication principle (AND) , permutations/combinations, distinguishable permutations and ways to count which combine these techniques, the Binomial Theorem).

- **Unit 6: Probability** (sample spaces, probability for equally-likely case scenarios, non-equally-likely case probability models, probability of simple events, probability of compound events (AND, OR rules), mutually-exclusive and independent events, conditional probability, Bayes' Formula problems, odds, Expected Value, Bernoulli Trials and the Binomial probability model).
- **Unit 7: Statistics** (measures of central tendency and spread: mean, median, mode, range, variance, standard deviation, knowing which to use depending upon distribution symmetry or skew, brief discussion of samples vs. populations, the Normal distribution and z-scores, use of calculator normalcdf and invNorm functions in word problem applications, Normal approximation for Binomial distributions).

3) Review of Precalculus topics: The semester finishes with a review of selected topics from honors algebra 2 (precalculus) and begins the study of calculus by introducing the topic of limits. Topics reviews are those most important to the study of calculus. Specific units in this section of the course are:

- **Unit 8: Precalculus Review** – not fully taught, but thoroughly reviewed (function notation and function properties – even/odd, intercepts, domain/range, interval notation, function family shapes, zeros and RH/LH behavior of polynomials and rational functions, asymptotes, piece-wise defined functions, exponential functions and logarithms, exponent base and log properties, interest and radioactivity problems, curve-fitting using linear and polynomial regression features on a calculator).
- **Unit 9: Trigonometry Review** – not fully taught, but thoroughly reviewed (right triangle SOHCAHTOA and non-right triangle, law of sines, law of cosines problems including word problems, radian angle measure, coterminal angles, arc length problems, use of the unit circle to define sine and cosine general functions, use of unit circle to locate any angle in degrees or radians and determine sine, cosine, brief review of simpler trig identities, exact form unit circle/trig identity problems such as evaluate cos(u-v) given sinu and sinv, inverse trig functions and solving trig equations).

(The final exam is actually taken between units 8 and 9, and we proceed into a study of limits before the end of the 1st semester, but since this is a calculus topic, I'll include it in the 2nd semester description.)

2nd semester – Brief Calculus

There are three general sections of the course which cover the following units and material:

1) Limits and Differential Calculus: Definition of limits and the derivative, computing derivatives and applications of derivatives. Specific units in this section of the course are:

- **Unit 10 (semester 1): Limits** (finding limits using tables and graphically, left- right-handed limits, the existence of a limit at a given x, algebraically find limits, resolving divide by zero algebraically by factoring, synthetic division, or rationalization, limits at infinity and infinite limits and their relationship to asymptotes, continuity of functions).
- **Unit 10 (semester 2): Definition of Derivative** (tangent to a curve, average rate of change vs. instantaneous rate of change, limit definition of the derivative, computing numerical derivative values and derivative functions, existence of derivative/differentiability, displacement and velocity.
- **Unit 11: Computing Derivatives** (derivative notations, power rule, sum/difference formulas, product/quotient formulas, chain rule and extended power rule, derivatives of exponential and logarithmic functions, implicit differentiation, logarithmic differentiation, higher-order derivative and velocity/acceleration including word problems.)
- **Unit 12: Applications of Derivatives** (curve sketching derivative as instantaneous rate of change/increasing/decreasing behavior, 2^{nd} derivative as concavity, first and second derivative tests, sketching given functions using derivatives, finding local max/min and absolute max/min over an interval using derivatives, optimization of real-world situations (word problems) using derivatives (in 2 variable systems or systems which can use substitution to create a single objective function to optimize), related rate problems).
- **Unit 13: Additional derivative topics** (special limits of trig functions, derivatives of trig functions –sine, cosine, tangent, L'Hopital's Rule.

2) Integral Calculus: Definition of integrals and their applications. Specific units in this section of the course are:

- **Unit 14: Definition and computation of Integrals/Antiderivatives** (definition of antiderivative, integration formulas for contant, power, exponential, and logarithmic functions, integration by substitution, integration by parts, area under a curve using Riemann Sum, Fundamental Theorem of Calculus and area under a curve using definite integral, properties of definite integrals, area between curves, solving separable differential equations).
- **Unit 15: Application of Integrals – Volumes of Solids of Revolution** (finding volumes of solids of revolution using disc and shell methods, including solids with 'voids' – washer method, rotation only around x- or y-axis).
- **Unit 16: Other applications of Integrals** (review of discrete probability methods – Binomial and addition of Poisson probability model, contrast to probability for continuous variables using integrals and probability density functions, Expected and Average Value of functions using integrals for continuous variable functions).

3) Introduction to Multivariate Calculus: A very brief introduction to selected topics in multivariable calculus, mainly focused on the course's theme of optimization:

- **Unit 17: Multivariable Calculus** (functions of two or more variables, domain or multivariable functions, partial derivatives, optimization of a multivariable objective function without constraints (min, max, saddle points, using partial derivatives and the Hessian Determinant), optimization of a multivariable objective function subject to constraints (using the method of Lagrange Multipliers).