WRHS Mathematics Curriculum
Syllabus

Course Name: Mathematics Modeling in Industry, Science and Government

Grade Level: 12

Course Description:

This course applies mathematical theory learned from Algebra through Calculus to problems that arise in the real world and require the utilization of mathematics to solve. Projects vary from year to year, though typical projects include an analysis of a company's yearly manufacturing capacity, the stress and potential for breaks due to manufacturing process, and using available data to determine when an electronic sensor is working or sending back false readings. Students will be required to prepare formal papers and presentations that analyze the information available and make recommendations. Topics included are statistics, calculus, game theory, and probability, many times using a combination of these and other various mathematical skills. This is the type of course taught in many engineering colleges as a freshman requirement. Some standard computer software packages such as Excel, Word, and PowerPoint will be utilized in this course.

Links to Student Expectations:

- All students will develop skills to utilize technology to gather, to evaluate, to assimilate, and to present information.
- All students will utilize critical thinking skills to identify and to provide resources to solve a problem.
- All students will learn to communicate critically, persuasively, and personally in both oral and written expression.
- All students will be able to make decisions and solve problems using logical processes (e.g., scientific method, induction, deduction, syllogism, etc.)
- All students will develop skills to promote a sense of confidence in tackling the rigors of standardized tests such as the required MCAS and optional AP, SAT.

Interdisciplinary Connections:

Mathematical modeling consists of using mathematical concepts to solve and analyze problems and concepts in non-mathematical fields of study. Due to the general nature of mathematical modeling, the interdisciplinary connections are vast and varied. Some of the current project available include an analysis of toxins in a water supply, examining a toy production system to see if the machinery is operating within acceptable limits, analyzing a company's manufacturing capacity, determining if an electronic sensor is operating properly or sending back false signals, and a comparison between the incidents of crime between the fifty states in seven major categories. Using a combination of mathematical modeling and background research, students will be exposed to such diverse areas as calculus, economics, the environment, manufacturing, history, and biology. Additionally, students will be required to present formal papers and presentations using correct English.

I. Essential Questions, Concepts, or Themes for Course

- What real world problems exist that can be solved, analyzed, examined through mathematical methods?
- What mathematical methods and technologies are available to analyze a given real world problem?
- How do you determine which methods and technologies are most appropriate for a given real world problem?
- How do you interpret the results of your analysis and experimentation?
- What methods are appropriate to clean-up and fill-in "messy" and incomplete data, and what effect does this have on the final analysis and recommendations?
- How do you use the Internet and current periodicals to perform background research on real world problems?

II. Student Objectives

- To understand the importance and application of mathematical modeling to non-mathematical fields of study
- To research general concepts and specific problems using periodicals, journals, and the internet with the intention of gather non-mathematical background information to aid in making recommendations
- To develop appropriate mathematical methods to analyze problems and situations which currently exist in science, industry, and the government
- To decide how to handle incomplete or "messy" data while being aware of how any assumptions might affect the outcome of the analysis
- To analyze the results of mathematical methods in order to provide recommendations on future actions
- To write a formal paper and present individual findings in a comprehensive and complete manner such that non-technical and non-mathematical individuals can understand

III. Suggestions for Instruction

- Lectures
- Discussion
- Individual or small group explorations
- Research in periodicals, journals, and on the internet
- Teacher conducted demonstrations of available technology

IV. Suggestion for Assessment

- Formal reports, to include:
    - background research of the problem
    - full explanation of all relevant mathematics used
    - recommendations based on any conclusions
- In-class presentations on final analysis and conclusions

V. Curriculum

- Mathematical modeling
- Calculus
    - Derivatives

        - Integration
    - Systems of Equations by Gauss-Jordan Elimination
    - Linear Programming using the Simplex Method
    - Control Charts
    - Statistics
        - mean, mode, median
        - standard deviation
        - histograms
        - box-and-whisker plots
        - chi-square statistic
    - Line of best fit and linear approximation
    - Game Theory
    - Computer programming and use of technology

VI. Lesson Extensions

- Development from scratch of individual projects, problems, and topical units, to include
    - Background research
    - Data collection
    - A list of potential questions and activities
    - Solutions to any questions or activities