PROFESSIONAL MATHEMATICS MAJOR COURSE LEVEL EXPECTATIONS

Course Description

Professional Mathematics @[0678] (1 unit, Gr. 11-12) This course will help to develop mathematical curiosity and problem solving skills, Professional math will introduce the applications of mathematics in areas such as cryptography, logic, graph theory, problem solving, and the math of personal finance. Students in this course are not expected to have especially strong math skills or scientific backgrounds; most calculations will be elementary although advanced material is taught as needed. Students will be exposed to number theory, graph theory, geometry, probability, and mathematical modeling. Concepts will be applied immediately to the problems that motivated them. **Prerequisite**: Geometry Concepts, Geometry or teacher recommendation.

Mathematical Practices:

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

Using Probability to Make Decisions	
S.MD.5	**Use probability to evaluate outcomes of decisions.**
S.MD.5	(+) Weigh the possible outcomes of a decision by assigning probabilities to payoff values and finding expected values. a. Find the expected payoff for a game of chance. *(*e.g.*, find the expected winnings from a state lottery ticket or a game at a fast-food restaurant)* b. Evaluate and compare strategies on the basis of expected values. (e.g., *compare a high deductible versus a low-deductible automobile insurance policy using various, but reasonable, changes of having a minor or a major accident)*
S.MD.6	(+) Use probabilities to make fair decisions (e.g., *drawing by lots, using a random number generator*).
S.MD.7	(+) Analyze decisions and strategies using probability concepts (e.g., *product testing, medical testing, pulling a hockey goalie at the end of a game*).
Modeling with Geometry	
G.MG.SPS	**Apply geometric concepts in modeling situations.**
G.MG.SPS.1	Draw or use models to represent and solve problems.
G.MG.SPS.2	Analyze and solve application problems involving circuits and paths to find optimal solutions.

G.MG.SPS.3	Evaluate whether a graph contains an Euler circuit or path.
G.MG.SPS.4	Evaluate whether a graph contains a Hamilton circuit or path.
G.MG.SPS.5	Apply Euler's and Hamilton's circuits and path to solve problems. (*e.g. traveling-salesman problems or routing problems*)
G.MG.SPS.6	Apply algorithms for determining if a graph contains an Euler circuit or Hamilton circuit.
G.MG.SPS.10	Construct tree graphs and determine the minimum spanning tree.
G.MG.SPS.11	Apply knowledge of tree graphs and minimum spanning trees to solve problems related to planning and scheduling, in order to find optimal solution.
Geometric Measurement and Dimension	
GMD.A	**Explain volume formulas and use them to solve problems**
GMD.A.1	Use geometric shapes, their measures and their properties to describe objects.
GMD.A.2	Use volume formulas for cylinders, pyramids, cones, spheres and composite figures to solve problems.
Modeling with Geometry	
G.MG.A	**Apply geometric concepts in modeling situations.**
G.MG.A.3	Apply geometric methods to solve design mathematical modeling problems.
Congruence (CO)	
G.CO.A	**Experiment with transformations in the plane.**
G.CO.A.1	Define angle, circle, perpendicular line, parallel line, line segment and ray based on the undefined notions of point, line, distance along a line and distance around a circular arc.
Making Inferences and Justifying Conclusions	
S.IC.SPS	**Make inferences and justify conclusions from sample surveys, experiments, and observational studies.**
S.IC.SPS.4	Apply the concepts of set theory, including Venn DIagrams, to model relationships and solve problems.
S.IC.SPS.5	Apply the principles of logic and truth tables to critique arguments and establish validity of conclusions.
Conditional Probability and rules of Probability	

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S.CP	**Understand solving equations as a process, and solve equations and inequalities in one variable.**
S.CP.1	Describe events as subsets of a sample space (the set of outcomes) using characteristics (or categories) of the outcomes or as unions, intersections, or complements of other events (“or,” “and,” “not”).
S.CP.2	Understand that two events A and B are independent if the probability of A and B occurring together is the product of their probabilities, and use this characterization to determine if they are independent.
S.CP.3	Understand the conditional probability of A given B as P(A and B)/P(B), and interpret independence of A and B as saying that the conditional probability of A given B is the same as the probability of A, and the conditional probability of B given A is the same as the probability of B.
S.CP	**Use the rules of probability to compute probabilities of compound events in a uniform probability model.**
S.CP.6	Find the conditional probability of A given B as the fraction of B's outcomes that also belong to A, and interpret the answer in terms of the model.
S.CP.7	Apply the Addition Rule, P(A or B) = P(A) + P(B) - P(A and B), and interpret the answer in terms of the model.
S.CP.8	(+) Apply the general Multiplication Rule in a uniform probability model, P(A and B) = P(A)P(B|A) = P(B)P(A|B), and interpret the answer in terms of the model.
S.CP.9	(+) Use permutations and combinations to compute probabilities of compound events and solve problems.
Using Probability to Make Decisions	
S.MD.6	(+) Use probabilities to make fair decisions (e.g., *drawing by lots, using a random number generator*).
Fundamental Counting and Probability	
S.SPS.1	Apply the Fundamental Counting Principle.
Number Theory	
NT.SPS.1	Introduce and use modular arithmetic to encrypt and decrypt codes.
NT.SPS.2	Understand the relationship between numbers.
Ratios and Proportional Relationships	
7.RP.A	**Analyze proportional relationships and use them to solve problems.**
7.RP.A.1	Compute unit rates, including those that involve complex fractions, with like or different units.

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Personal Finance Applications	
PF.SPS.1	Calculate simple interest, compound interest, annuities, loan amortization schedules.

1. Connecting professions to mathematics and applying mathematics to professional situations - Modeling links classroom mathematics and statistics to everyday life, work, and decision-making. Modeling is the process of choosing and using appropriate mathematics and statistics to analyze empirical situations, to understand them better, and to improve decisions. Quantities and their relationships in physical, economic, public policy, social, and everyday situations can be modeled using mathematical and statistical methods. When making mathematical models, technology is valuable for varying assumptions, exploring consequences, and comparing predictions with data.

2. Following the modeling cycle to analyze situations and problems in various professions - The basic modeling cycle is summarized below: It involves:
    a. identifying variables in the situation and selecting those that represent essential features
    b. formulating a model by creating and selecting geometric, graphical, tabular, algebraic, or statistical representations that describe relationships between the variables
    c. analyzing and performing operations on these relationships to draw conclusions,
    d. interpreting the results of the mathematics in terms of the original situation
    e. validating the conclusions by comparing them with the situation, and then either improving the model or, if it is acceptable
    f. reporting on the conclusions and the reasoning behind them. Choices, assumptions, and approximations are present throughout this cycle