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Survey of Mathematics | Table of Contents

- Set Relationships
    - Determine the complement of a set using Venn diagrams and proper set notation
    - Determine the intersection of two sets using Venn diagrams and set notation
    - Determine the union of two sets using Venn diagrams and set notation
- Set Operations
    - Perform operations on sets
    - Find the difference and cartesian product of two sets
    - Use Venn diagrams to find the result of set operations on two sets
    - Determine the cardinal number of a union of two finite sets

2.3 Venn Diagrams with Three Sets and Verification of Equality of Sets

- Construct a Venn Diagram of Three Sets
    - Perform set operations on three sets
    - Represent three sets using Venn diagrams
- Verification of Equality of Sets
    - Show that two combinations of sets are equal using Venn diagrams
    - Apply De Morgan's law using Venn diagrams

2.4 Applications of Sets

- Solving Survey Problems
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Chapter 3: Logic

3.1 Statements and Logical Connectives

- The Building Blocks of Logic
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    - Identify and negate quantified statements
- Symbolic Representation of Statements
    - Identify logical connectives and compound statements
    - Represent and/or/not statements in symbolic form and English
- Conditional Statements
    - Represent conditional statements in symbolic form and English
    - Write biconditional statements in symbolic form and English
    - Represent symbolic statements with parentheses using dominance of connectives

3.2 Truth Tables for Negation, Conjunction, and Disjunction

- Introduction to Truth Tables
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3.3 Truth Tables for the Conditional and Biconditional

- Truth Tables for Conditional and Biconditional Statements
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3.5 Symbolic Arguments

- Drawing and Verifying Conclusions
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3.6 Euler Diagrams and Syllogistic Arguments

- Euler Diagrams and Syllogistic Arguments
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- Switching Circuits and Symbolic Logic
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Chapter 4: Systems of Numeration

4.1 Additive, Multiplicative, and Ciphered Systems of Numeration

- Additive Number Systems
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    - Convert between Roman Numerals and Hindu-Arabic Numerals
- Multiplicative and Ciphered Number Systems
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- Hindu-Arabic, Babylonian, and Mayan Numerals
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    - Convert from base 10 to a system with a base less than 10
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    - Perform addition in bases other than 10 using mental arithmetic
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4.5 Early Computational Methods
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    - Multiply two numbers using lattice multiplication
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Chapter 5: Number Theory and the Real Number System

5.1 Number Theory
- Prime Factorization, Greatest Common Factors, and Least Common Multiples
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5.2 The Integers
- Introduction to Integers
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    - Order and compare integers
    - Understand and evaluate absolute value

- Add and Subtract Integers
    - Understand additive inverse
    - Understand distance in terms of absolute value
    - Add and subtract integers
- Multiply and Divide Integers
    - Multiply integers
    - Divide integers

5.3 The Rational Numbers

- Introduction to Fractions
    - Understand fractions and their models
    - Convert between fractions and mixed numbers
    - Find equivalent fractions
- Introduction to Decimals
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    - Convert fractions to decimals
    - Convert a repeating decimal to a fraction
- Multiply and Divide Fractions
    - Multiply fractions
    - Find reciprocals of fractions
    - Divide fractions
- Add and Subtract Fractions
    - Add and subtract fractions with like denominators
    - Add and subtract fractions with unlike denominators
    - Add and subtract fractions in applications

5.4 Irrational Numbers, Radicals, and the Real Number System

- Irrational Numbers and Simplifying Radicals
    - Distinguish between rational and irrational numbers
    - Evaluate square roots
    - Use the product rule to simplify square roots
    - Use the quotient rule to simplify square roots
- Operations with Radicals
    - Add and subtract square roots
    - Rationalize denominators with a monomial denominator
    - Rationalize denominators using the conjugate

5.5 Real Numbers and Their Properties

- Properties of Real Numbers
    - Distinguish between natural numbers, whole numbers, and integers
    - Use the following properties of real numbers: commutative, associative, and distributive

5.6 Rules of Exponents and Scientific Notation

- Properties of Exponents
    - Understand exponent notation
    - Use the product rule of exponents
    - Use the quotient rule of exponents
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- Advanced Properties of Exponents
    - Use the negative and zero exponent rule
    - Find the power of a product
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    - Simplify exponential expressions
- Scientific Notation
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    - Multiply and divide numbers in scientific notation using a calculator

5.7 Arithmetic and Geometric Sequences

- Arithmetic Sequences
    - Write the terms of a sequence defined by an explicit formula
    - Find the common difference of an arithmetic sequence
    - Write terms of an arithmetic sequence
    - Write an explicit formula for an arithmetic sequence
- Arithmetic Series
    - Evaluate expressions using summation notation
    - Find the sum of a finite arithmetic series
- Geometric Sequences and Series
    - Find the common ratio of a geometric sequence
    - Write terms of a geometric sequence
    - Write an explicit formula for a geometric sequence
    - Find the sum of a finite geometric series

Chapter 6: Algebra, Graphs, and Functions

6.1 Algebraic Expressions and the Order of Operations

- Simplifying Algebraic Expressions using Order of Operations
    - Perform calculations using order of operations
    - Identify constants and variables
    - Simplify algebraic expressions
- Evaluating Algebraic Expressions
    - Evaluate algebraic expressions with a single variable
    - Evaluate algebraic expressions with two variables

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6.2 Linear Equations

- Solve Linear Equations in One Variable
    - Identify identity, conditional, and inconsistent equations
    - Solve equations in one variable algebraically, variable just on one side
    - Solve equations in one variable algebraically, variable on both sides
    - Solve equations using cross multiplication

6.3 Formulas

- Using Formulas
    - Use a formula
    - Solve a formula for a given variable
- Exponential Formulas
    - Model exponential growth
    - Model exponential decay

6.4 Applications of Linear Equations in One Variable

- Solving Linear Equation Application Problems
    - Set up a linear equation to solve a real-world application
    - Translate verbal expressions into mathematical expressions
    - Use a formula to solve a real-world application

6.5 Variation

- Solving Variation Problems
    - Solve direct variation problems
    - Solve inverse variation problems
    - Solve problems involving joint variation
    - Solve combined variation problems

6.6 Linear Inequalities

- Linear Inequalities in One Variable
    - Use interval notation
    - Use properties of inequalities
    - Solve simple inequalities in one variable algebraically

6.7 Graphing Linear Equations

- Introduction to Graphing
    - Plot ordered pairs in a Cartesian coordinate system
    - Graph equations by plotting points
    - Graph a linear equation using the slope and the origin
- Finding Linear Equations
    - Find equation of a line, in slope-intercept form, given slope and one point (point-slope formula)
    - Find equation, in slope-intercept form, of a line passing through two given points
    - Given slope and intercept, find the equation of a line and write it in standard form

- Vertical, Horizontal, Parallel, and Perpendicular Lines
    - Find the equation of vertical and horizontal lines
    - Given the equations of two lines, determine whether their graphs are parallel or perpendicular
    - Write the equation of a line parallel to a given line
    - Write the equation of a line perpendicular to a given line

6.8 Linear Inequalities in Two Variables

- Linear Inequalities in Two Variables
    - Solve linear inequalities in two variables
    - Solve a linear inequality in two variables by graphing

6.9 Solving Quadratic Equations

- Factoring Trinomials
    - Factor a trinomial
    - Factor a trinomial by grouping
    - Factor a perfect square trinomial
    - Factor a difference of squares
- Solving Quadratic Equations by Factoring
    - Solve quadratic equations by factoring, leading coefficient 1
    - Solve quadratic equations by factoring, leading coefficient > 1
    - Use the discriminant to classify the solutions of a quadratic equation
    - Solve quadratic equations by using the quadratic formula

6.10 Linear and Quadratic Functions and their Graphs

- Relations and Functions
    - Identify domain and range from a set of ordered pairs
    - Determine whether a relation represents a function
    - Use the vertical line test to identify functions
- Graphs of Linear Functions
    - Represent a linear function in table form
    - Determine whether a linear function is increasing, decreasing, or constant
    - Graph linear functions
- Graphs of Quadratic Function
    - Determine axis of symmetry and vertex of parabolas from a graph
    - Determine x- and y-intercepts of parabolas from a graph
- Properties of Quadratic Functions
    - Find the direction a parabola opens and its axis of symmetry and vertex from the general form of its equation
    - Identify the axis of symmetry and vertex of a parabola from its equation in standard form
    - Find the domain and range of a quadratic function
    - Determine the maximum and minimum values of quadratic functions

6.11 Exponential Functions

- Identify and Evaluate Exponential Functions
    - Identify exponential functions
    - Evaluate exponential functions
    - Calculate continuous growth and decay
- Graphing Exponential Functions
    - Graph exponential functions
    - Graph exponential functions using transformations

Chapter 7: Systems of Linear Equations and Inequalities

7.1 Systems of Linear Equations

- Solutions to Systems of Linear Equations
    - Determine whether an ordered pair is a solution to a system of equations
    - Solve systems of equations in two variables by graphing
    - Identify inconsistent and dependent systems of equations containing two variables, and express the solution of dependent equations

7.2 Solving Systems of Linear Equations by the Substitution and Addition Methods

- Solving Systems of Linear Equations
    - Solve systems of equations in two variables by substitution
    - Solve systems of equations in two variables by addition
- Applications of Systems of Linear Equations
    - Use systems of equations to investigate profits
    - Write and solve a system of equations in two variables from a word problem

7.3 Matrices

- Introduction to Matrices
    - Determine the order of a matrix and describe elements within a matrix
    - Add or subtract matrices
- Matrix Multiplication and the Identity Matrix
    - Multiply a matrix by a scalar
    - Find the sum or difference of scalar multiples
    - Multiply two matrices
    - Understand the identity matrix and how it relates to the inverse matrix

7.4 Solving Systems of Linear Equations by Using Matrices

- Solving Systems with Gaussian Elimination
    - Convert between a system of equations and its corresponding augmented matrix
    - Use row operations to solve a system of linear equations in two variables

7.5 Systems of Linear Inequalities

- Solving Systems of Linear Inequalities
    - Solve a linear system of inequalities by graphing

7.6 Linear Programming

- Maximizing Profits using Linear Programming
    - Graph a feasible region given a set of constraints
    - Find the maximum value of an objective function given constraints by graphing
    - Solve application problems using linear programming

Chapter 8: The Metric System

8.1 Basic Terms and Conversions Within the Metric System

- Measurements and the SI system
    - Recognize general measurement and SI units
    - Convert between units with different prefixes

8.2 Length, Area, and Volume

- Length, Area, and Volume
    - Identify units of length, area, or volume correctly for a given measurement
    - Calculate the volume of a shape given the formula

8.3 Mass and Temperature

- Mass and Temperature
    - Identify unit of mass correctly for a given situation
    - Convert between celsius and fahrenheit

8.4 Dimensional Analysis and Conversions to and from the Metric System

- Dimensional Analysis
    - Convert between non-metric units using dimensional analysis
    - Convert between non-metric units and metric units using dimensional analysis

Chapter 9: Geometry

9.1 Points, Lines, Planes, and Angles

- Points, Lines, and Planes
    - Construct a line, line segment, and ray given two points
    - Find the intersection or union of two line segments, a ray and a line segment, or two rays
    - Identify planes
- Angles
    - Identify right, acute, obtuse, and straight angles
    - Understand supplementary and complementary angles
    - Understand alternate interior angles, alternate exterior angles, and corresponding angles

9.2 Polygons

- Polygons
    - Identify polygons given their properties
    - Use properties of similar polygons to solve for a missing side
    - Determine the measure of an angle using properties of polygons

- Triangles
    - Identify triangles given their properties
    - Use properties of triangles and right angles
    - Use properties of similar triangles to solve for a missing side or angle
    - Use the Pythagorean theorem

9.3 Perimeter and Area

- Area of Triangles and Quadrilaterals
    - Find the area of a rectangle
    - Find the area of a non-rectangular quadrilateral
    - Find the area of a triangle
    - Find the area of complex polygons
- Circles
    - Find the circumference and area of circles
    - Find the area of complex shapes including circles
- Perimeter and Applications
    - Calculate perimeter
    - Solve application problems involving area and perimeter

9.4 Volume and Surface Area

- Volume and Surface Area of Conventional Solids
    - Find the volume and surface area of rectangular solids
    - Find the volume of spheres, cylinders, and cones
    - Find the surface area of spheres and cylinders
- Volume and Surface Area of Other Solids
    - Find the volume and surface area of non-rectangular prisms
    - Find the volume and surface area of a pyramid
    - Use Euler's polyhedron formula to understand the relationship between vertices, edges, and faces in a polyhedron

9.5 Transformational Geometry, Symmetry, and Tessellations

- Reflections and Translations
    - Reflect a polygon across an axis
    - Translate a polygon given a translation vector
    - Perform a glide reflection on a polygon
- Rotations
    - Rotate a polygon given an angle of rotation and a center of rotation outside the polygon
    - Rotate a polygon given an angle of rotation and a center of rotation inside the polygon
- Symmetry
    - Determine if a polygon has reflective symmetry across an axis
    - Determine if a polygon has rotational symmetry about a point

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Chapter 10: Mathematical Systems

10.1 Mathematical Systems

- Introduction to Mathematical Systems
    - Recognize mathematical systems
- Properties of a Mathematical System
    - Determine if a mathematical system is closed under an operation
    - Determine if a mathematical system is commutative and/or associative under an operation
    - Identify the identity element and the inverse of an element in a mathematical system
    - Determine the elements in the set, the binary operation, and the properties of a finite system defined by a given table
- Groups
    - Determine if a mathematical system is a group

10.2 Clock and Modular Arithmetic

- Clocks as a Mathematical System
    - Solve problems involving the finite mathematical system 'clock 12 arithmetic'
- Modular Arithmetic
    - Determine if two numbers are congruent in a modulo m system
    - Add and subtract two numbers in a modulo m system
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Chapter 11: Consumer Mathematics

11.1 Percent, Sales Tax, and Income Tax

- Percents and Change
    - Convert between percents, decimals, and fractions
    - Calculate a percent increase or a percent decrease
- Discounts and Income Tax
    - Determine the final cost of an item including sales tax and discounts
    - Calculate income tax

11.2 Simple Interest

- Simple Interest
    - Calculate simple interest
    - Calculate interest discounts on a discounted loan

11.3 Compound Interest

- Compound Interest
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    - Calculate compound interest
    - Calculate continuously compounded interest
    - Calculate effective annual yield

11.4 Annuities, Stocks, and Bonds

- Annuities
    - Calculate the value of an annuity
    - Calculate the payment needed to achieve a determined future value
- Stocks
    - Define stock terminology
    - Read a stock table

11.5 Installment Loans, Amortization, and Credit Cards

- Mortgages and Loans
    - Calculate the monthly payment and interest cost for a mortgage
    - Construct a loan amortization schedule
    - Choose the best installment loan plan
- Credit Cards
    - Recognize key features of credit cards
    - Calculate the average daily balance of a credit card
    - Determine interest to be paid on a card's next billing date

Chapter 12: Probability and Counting Methods

12.1 The Fundamental Counting Principle

- The Fundamental Counting Principle
    - Solve counting problems using the addition principle
    - Solve counting problems using the multiplication principle

12.2 Permutations and Combinations

- Permutations
    - Evaluate an expression with factorials
    - Find the number of permutations of n distinct objects using the multiplication principle
    - Find the number of permutations of n distinct objects using a formula
    - Find the number of permutations of n non-distinct objects
- Combinations
    - Find the number of combinations using the formula
    - Find the number of subsets of a set

12.3 Fundamentals of Probability

- Fundamentals of Probability
    - Compute the probability of equally likely outcomes
    - Compute the probability of equally likely outcomes in application
- Probability with Permutations and Combinations
    - Compute probability involving permutations
    - Compute probability involving combinations

- The Complement Rule and Probability
    - Use the complement rule to compute probabilities
    - Compute the probability of an event happening at least once

12.4 Events, Sample Spaces, and Odds

- Sample Spaces and Events
    - Determine the sample space of an experiment
    - Determine an event of an experiment
- Odds and Expected Value
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    - Compute odds using probability

12.5 Conditional Probability, Independent, and Dependent Variables

- Independent Events
    - Compute the probability of the union of two events
    - Compute the probability of two independent events occurring
- Dependent Events and Conditional Probability
    - Compute the conditional probability of a dependent event occurring
    - Compute the probability of two or more dependent events occurring

12.6 Random Variables, Probability Distributions and Expected Value

- Random Variables, Probability Distributions, and Expected Value
    - Calculate probability distribution
    - Calculate the expected value of a random variable

Chapter 13: Statistics

13.1 Sampling, Frequency Distributions, and Graphs

- Sampling and Parameters
    - Understand the definitions of population, sampling, statistic, parameter, and data
    - Identify stratified, cluster, systematic, and convenience sampling
    - Identify sampling errors and bias
    - Identify situations in which statistics can be misleading
- Frequency Distributions and Histograms
    - Construct and understand frequency tables for a set of data
    - Create and interpret histograms
    - Create and interpret stem-and-leaf plots

13.2 Measures of Central Tendency

- Means and Medians
    - Find the mean of a set of data
    - Find the mean from a frequency table
    - Find the median of a set of data

- Modes, Midranges, and Choosing a Measurement
    - Find the mode of a set of data
    - Find the midrange of a set of data
    - Determine whether the mean, median, or mode is the best measure of center for a data set

13.3 Measures of Dispersion

- Standard Deviation
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13.4 The Normal Distribution, Margins of Error, and Skewness

- The Normal Distribution
    - Understand the notation and interpret the parameters of a normal distribution
    - Compute z-scores and use them to compare values from different data sets
    - Determine if a data set is skewed
- Percentiles, Quartiles, and Margins of Error
    - Find and interpret percentiles and quartiles of a data set
    - Calculate and interpret margin of error
- Problem Solving with the Normal Distribution
    - Standardize a normally distributed random variable
    - Calculate the mean and standard deviation of a standard normal distribution

13.5 Scatter Plots, Correlations, and Regression Lines

- Scatter Plots, Correlations, and Regression Lines
    - Understand the relationship between scatter plots and table and determine patterns
    - Find the linear regression equation given a list of data points
    - Find and interpret the correlation coefficient
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Chapter 14: Graph Theory

14.1 Graphs, Paths, and Circuits

- Modeling Relationships with Graphs
    - Recognize equivalent graphs
    - Construct a simple graph to model relationships using information given
- Basics of Graph Theory
    - Determine the degree of a vertex
    - Identify adjacent vertices
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    - Distinguish between connected and disconnected graphs

14.2 Euler Paths and Euler Circuits

- Euler Paths and Euler Circuits
    - Identify Euler paths and circuits
    - Determine if a graph has a circuit using Euler's theorem
    - Solve application problems using Euler's theorem
    - Implement Fleury's algorithm to find Euler circuits when they exist

14.3 Hamilton Paths and Hamilton Circuits

- Hamilton Paths and Hamilton Circuits
    - Identify a Hamilton path and a Hamilton circuit for a given graph
    - Determine the number of Hamilton circuits in a graph
- Weighted Graphs
    - Identify the optimal Hamilton circuit using the brute force method
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- Trees
    - Identify a tree
    - Develop a spanning tree for a given graph
    - Use Kruskal's Algorithm to find a minimum spanning tree

Chapter 15: Voting and Apportionment

15.1 Voting Methods

- Preference Tables and the Plurality Method
    - Identify elements of a preference table
    - Choose the winner of an election using the plurality method
- Choosing a Winner
    - Determine the winner of an election using the Borda count method
    - Decide the winner of an election using the plurality with elimination method
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15.2 Flaws of the Voting Methods

- Understanding the Fairness of a Voting System
    - Determine a voting systems fairness using the majority criterion
    - Determine a voting systems fairness using the head to head count criterion
    - Determine a voting system's fairness using the monotonicity criterion
    - Determine a voting system's fairness using the irrelevant alternatives criterion
    - Choose the best voting system for a given election

15.3 Apportionment Methods

- Standard Divisors and Standard Quotas
    - Determine the standard quota for a state given its population
    - Calculate the lower and upper quotas for a state given its population

- Apportionment Methods
    - Use Hamilton's method of determining apportionment
    - Use Jefferson's method of determining apportionment
    - Use Adam's method of determining apportionment
    - Use Webster's method of determining apportionment

15.4 Flaws of the Apportionment Methods

- Flaws of the Apportionment Methods
    - Identify where the Alabama paradox occurs
    - Identify where the population paradox occurs
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    - Choose the best apportionment system for a given region