KNEWTON

Survey of Mathematics

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Source	Author(s) (Text or Video)	Title(s)	Link (where applicable)
OpenStax	Various	Various	OpenStax
Mathispower4u	James Sousa	MathIsPower4U	Mathispower4U Videos

Knewton Survey of Mathematics was developed to meet the scope and sequence of a typical one semester Survey of Mathematics course. To develop the course, Knewton used a variety of different source content, including OpenStax, videos created by a Math Professor we have partnered with, and a team of Subject Matter Experts (SMEs). The SMEs come from diverse backgrounds and are all accomplished academics in the field of Mathematics.

Knewton Survey of Mathematics has two instructional sequences for every learning objective, giving students multiple opportunities to learn new concepts. Between our OpenStax, Video, and Knewton SMEs, we were able to solicit ideas from math instructors and students at all levels of higher education. Knewton Survey of Mathematics covers the typical breadth of survey topics and also provides the necessary depth to ensure the course is manageable and engaging for instructors and students alike.

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Survey of Mathematics | Table of Contents

Chapter 1: Critical Thinking Skills

Inductive and Deductive Reasoning

- Inductive and Deductive Reasoning
    - Understand and use inductive reasoning
    - Understand and use deductive reasoning

Estimation

- Estimation by Rounding
    - Estimate a value by rounding a whole number
    - Estimate a value by rounding a decimal
- Estimation from Graphs/Figures
    - Estimate using a pie chart or bar graph
    - Estimate using a line graph

Problem Solving

- Problem Solving
    - Identify the piece of information needed to solve a problem and unnecessary information given in a problem
    - Solve an application problem by applying Polya's four step procedure

Chapter 2: Sets

Set Concepts

- Introduction to Sets and Set Builder Notation
    - Represent a set using a written description and the roster method
    - Represent a set using set builder notation
- Set Equivalence
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    - Determine if two sets are equivalent
    - Determine if two sets are equal
- Types of Sets
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    - Distinguish between finite and infinite sets
- Subsets and Proper Subsets
    - Identify subsets and proper subsets using set notation
    - Determine the number of subsets and proper subsets in a given set

Venn Diagrams and Set Operations

- Representing Sets with Venn Diagrams
    - Illustrate the universal set, a set, and complement of a set using a Venn diagram
    - Illustrate two sets using Venn diagram and set notation

- 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
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    - Determine the cardinal number of a union of two finite sets

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
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    - Apply De Morgan's law using Venn diagrams

Applications of Sets

- Solving Survey Problems
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Chapter 3: Logic

Statements and Logical Connectives

- The Building Blocks of Logic
    - Identify and negate simple statements
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- Symbolic Representation of Statements
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    - Represent and/or/not statements in symbolic form and English
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    - Represent symbolic statements with parentheses using dominance of connectives

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- Introduction to Truth Tables
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    - Construct a truth table for a statement with a disjunction and/or a negation and determine its truth value
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Truth Tables for the Conditional and Biconditional

- Truth Tables for Conditional and Biconditional Statements
    - Construct a truth table for a conditional statement and determine its truth value
    - Construction a truth table for a biconditional statement and determine its truth value
- Self-Contradictions, Tautologies, and Implications
    - Identify self-contradictions, tautologies, and implications

Equivalent Statements

- Equivalent Statements and De Morgan's Equivalence Laws
    - Determine if two symbolic statements are equivalent using a truth table
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- Conditional States and Equivalence
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    - Determine if two conditional statements are equivalent

Symbolic Arguments

- Drawing and Verifying Conclusions
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    - Identify and validate the standard forms of arguments

Euler Diagrams and Syllogistic Arguments

- Euler Diagrams and Syllogistic Arguments
    - Identify syllogistic arguments
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    - Determine if a syllogistic argument is valid with a Euler diagram

Switching Circuits

- Switching Circuits and Symbolic Logic
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    - Determine if two switching circuits are equivalent

Chapter 4: Systems of Numeration

Additive, Multiplicative, and Ciphered Systems of Numeration

- Additive Number Systems
    - Convert between Egyptian Numerals and Hindu-Arabic Numerals
    - Convert between Roman Numerals and Hindu-Arabic Numerals
- Multiplicative and Ciphered Number Systems
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    - Convert between Ionic Greek Numerals and Hindu-Arabic Numerals

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- Hindu-Arabic, Babylonian, and Mayan Numerals
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    - Convert between Babylonian Numerals and Hindu-Arabic Numerals
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Other Bases

- Bases Less Than 10
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    - Convert from base 10 to a system with a base less than 10
- Bases Greater Than 10
    - Convert from a system with a base greater than 10 to base 10
    - Convert from base 10 to a system with a base greater than 10

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- Addition and Subtraction in Other Bases
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    - Perform addition in bases other than 10 using mental arithmetic
    - Perform subtraction in bases other than 10
- Multiplication and Division in Other Bases
    - Perform multiplication in bases other than 10
    - Perform division in bases other than 10

Early Computational Methods

- Early Computational Methods
    - Multiply two numbers using duplation and mediation
    - Multiply two numbers using lattice multiplication
    - Multiply two numbers using Napier's rods

Chapter 5: Number Theory and the Real Number System

Number Theory

- Prime Factorization, Greatest Common Factors, and Least Common Multiples
    - Understand and identify prime and composite numbers
    - Find the GCF and LCM of two or more numbers
    - Find the prime factorization of a number

The Integers

- Introduction to Integers
    - Understand integers and find opposites of numbers
    - 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

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
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    - Add and subtract fractions with unlike denominators
    - Add and subtract fractions in applications

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

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

Rules of Exponents and Scientific Notation

- Properties of Exponents
    - Understand exponent notation
    - Use the product rule of exponents
    - Use the quotient rule of exponents
    - Use the power rule of exponents

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

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

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

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

Formulas

- Using Formulas
    - Use a formula
    - Solve a formula for a given variable

- Exponential Formulas
    - Model exponential growth
    - Model exponential decay

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

Variation

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

Linear Inequalities

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

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

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

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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

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

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

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Chapter 7: Systems of Linear Equations and Inequalities

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

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

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

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

Systems of Linear Inequalities

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

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

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

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

Mass and Temperature

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

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

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

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

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

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

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
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Chapter 10: Mathematical Systems

Mathematical Systems

- Introduction to Mathematical Systems
    - Recognize mathematical systems
- Properties of a Mathematical Systems
    - 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

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

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

Simple Interest

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

Compound Interest

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

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

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

The Fundamental Counting Principle

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

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

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

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
    - Compute the expected value of an event
    - Compute odds using probability

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

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

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

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

Measures of Dispersion

- Standard Deviation
    - Compute the sample variance and sample standard deviation
    - Interpret the standard deviation of a set of data

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

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
    - Make predictions using a line of best fit
    - Find outliers in a data set

Chapter 14: Graph Theory

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
    - Recognize circuits
    - Distinguish between connected and disconnected graphs

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

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
    - Identify the optimal Hamilton circuit using the nearest neighbor method

Trees

- Trees
    - Identify a tree
    - Develop a spanning tree for a given graph
    - Use Kruskal's Algorithm to find a minimum spanning tree

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Chapter 15: Voting and Apportionment

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
    - Select the winner of an election using the pairwise comparison method

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

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

Flaws of the Apportionment Methods

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