Fair Lawn
Public Schools
Fair Lawn, NJ

Statistics & Discrete Mathematics

Adopted August

2015

Revised August 2015
Developed August 2012

The Discrete Mathematics/Statistics course has been designed for the regular math student and is aligned with the Common Core State Standards.

Statistics & Discrete Mathematics

Fair Lawn School District

Committee Credits
AP Statistics Team

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Statistics & Discrete Mathematics

I. Course Synopsis

The Discrete math curriculum develops mathematical skills designated by the High School Specific Common Core State Standards. Throughout the year, students will explore multiple concepts in both Discrete mathematics and Statistical analysis. The students will cover the Discrete topics of Election Theory, Cryptography, Coding, Circuits, Paths, Map Coloring, Vertex Coloring, and Scheduling. In Statistics students will cover measures of central tendency, normal distribution, standard deviations, and ways to present statistical findings through plots and graphs. In addition, students will complete project based assignments to demonstrate their understanding of the models and what they represent. Essential questions, thematic focus, and integrated cross-curricular study (with Science partners) intensify analysis, evaluation, and synthesis of text-based academic discourse.

II. Philosophy & Rationale

The purpose of the math curriculum for Discrete Mathematics and Statistics is to help students develop and enhance mathematical abilities numerically, algebraically, spatially, and theoretically. Students should be able to reason logically and apply mathematical skills to real-world activities. Communicating about and through mathematics will enable students to view mathematics as relevant to their lives and understand it as it connects to other areas. Students should be able to make connections among the different strands of mathematics while feeling confident in using quantitative and spatial information to make decisions. The curriculum will enable students to become independent learners with a desire for lifelong learning. Technology will be infused through the curriculum so that students will be proficient as 21st century learners.

The Standards for Mathematical Practice describe varieties of expertise that mathematics educators at all levels should seek to develop in their students. These practices rest on important "processes and proficiencies" with longstanding importance in mathematics education. The first of these are the NCTM process standards of problem solving, reasoning and proof, communication, representation, and connections. The second are the strands of mathematical proficiency specified in the National Research Council's report Adding It Up: adaptive reasoning, strategic competence, conceptual understanding (comprehension of mathematical concepts, operations and relations), procedural fluency (skill in carrying out procedures flexibly, accurately, efficiently and appropriately), and productive disposition (habitual inclination to see mathematics as sensible, useful, and worthwhile, coupled with a belief in diligence and one's own efficacy).

CCSS.MATH.PRACTICE.MP1 - Make sense of problems and persevere in solving them.
Mathematically proficient students start by explaining to themselves the meaning of a problem and looking for entry points to its solution. They analyze givens, constraints, relationships, and goals. They make conjectures about the form and meaning of the solution and plan a solution

pathway rather than simply jumping into a solution attempt. They consider analogous problems, and try special cases and simpler forms of the original problem in order to gain insight into its solution. They monitor and evaluate their progress and change course if necessary. Older students might, depending on the context of the problem, transform algebraic expressions or change the viewing window on their graphing calculator to get the information they need. Mathematically proficient students can explain correspondences between equations, verbal descriptions, tables, and graphs or draw diagrams of important features and relationships, graph data, and search for regularity or trends. Younger students might rely on using concrete objects or pictures to help conceptualize and solve a problem. Mathematically proficient students check their answers to problems using a different method, and they continually ask themselves, "Does this make sense?" They can understand the approaches of others to solving complex problems and identify correspondences between different approaches.

CCSS.MATH.PRACTICE.MP2 - Reason abstractly and quantitatively.
Mathematically proficient students make sense of quantities and their relationships in problem situations. They bring two complementary abilities to bear on problems involving quantitative relationships: the ability to *decontextualize*—to abstract a given situation and represent it symbolically and manipulate the representing symbols as if they have a life of their own, without necessarily attending to their referents—and the ability to *contextualize*, to pause as needed during the manipulation process in order to probe into the referents for the symbols involved. Quantitative reasoning entails habits of creating a coherent representation of the problem at hand; considering the units involved; attending to the meaning of quantities, not just how to compute them; and knowing and flexibly using different properties of operations and objects.

CCSS.MATH.PRACTICE.MP3 - Construct viable arguments and critique the reasoning of others.
Mathematically proficient students understand and use stated assumptions, definitions, and previously established results in constructing arguments. They make conjectures and build a logical progression of statements to explore the truth of their conjectures. They are able to analyze situations by breaking them into cases, and can recognize and use counterexamples. They justify their conclusions, communicate them to others, and respond to the arguments of others. They reason inductively about data, making plausible arguments that take into account the context from which the data arose. Mathematically proficient students are also able to compare the effectiveness of two plausible arguments, distinguish correct logic or reasoning from that which is flawed, and—if there is a flaw in an argument—explain what it is. Elementary students can construct arguments using concrete referents such as objects, drawings, diagrams, and actions. Such arguments can make sense and be correct, even though they are not generalized or made formal until later grades. Later, students learn to determine domains to which an argument applies. Students at all grades can listen or read the arguments of others, decide whether they make sense, and ask useful questions to clarify or improve the arguments.

CCSS.MATH.PRACTICE.MP4 - Model with mathematics.
Mathematically proficient students can apply the mathematics they know to solve problems arising in everyday life, society, and the workplace. In early grades, this might be as simple as writing an addition equation to describe a situation. In middle grades, a student might apply proportional reasoning to plan a school event or analyze a problem in the community. By high school, a student might use geometry to solve a design problem or use a function to describe how one quantity of interest depends on another. Mathematically proficient students who can apply what they know are comfortable making assumptions and approximations to simplify a complicated situation, realizing that these may need revision later. They are able to identify important quantities in a practical situation and map their relationships using such tools as diagrams, two-way tables, graphs, flowcharts and formulas. They can analyze those relationships mathematically to draw conclusions. They routinely interpret their mathematical results in the context of the situation and reflect on whether the results make sense, possibly improving the model if it has not served its purpose.

CCSS.MATH.PRACTICE.MP5 - Use appropriate tools strategically.
Mathematically proficient students consider the available tools when solving a mathematical problem. These tools might include pencil and paper, concrete models, a ruler, a protractor, a calculator, a spreadsheet, a computer algebra system, a statistical package, or dynamic geometry software. Proficient students are sufficiently familiar with tools appropriate for their grade or course to make sound decisions about when each of these tools might be helpful, recognizing both the insight to be gained and their limitations. For example, mathematically proficient high school students analyze graphs of functions and solutions generated using a graphing calculator. They detect possible errors by strategically using estimation and other mathematical knowledge. When making mathematical models, they know that technology can enable them to visualize the results of varying assumptions, explore consequences, and compare predictions with data. Mathematically proficient students at various grade levels are able to identify relevant external mathematical resources, such as digital content located on a website, and use them to pose or solve problems. They are able to use technological tools to explore and deepen their understanding of concepts.

CCSS.MATH.PRACTICE.MP6 - Attend to precision.
Mathematically proficient students try to communicate precisely to others. They try to use clear definitions in discussion with others and in their own reasoning. They state the meaning of the symbols they choose, including using the equal sign consistently and appropriately. They are careful about specifying units of measure, and labeling axes to clarify the correspondence with quantities in a problem. They calculate accurately and efficiently, express numerical answers with a degree of precision appropriate for the problem context. In the elementary grades, students give carefully formulated explanations to each other. By the time they reach high school they have learned to examine claims and make explicit use of definitions.

CCSS.MATH.PRACTICE.MP7 - Look for and make use of structure.
Mathematically proficient students look closely to discern a pattern or structure. Young students, for example, might notice that three and seven more is the same amount as seven and three more, or they may sort a collection of shapes according to how many sides the shapes have. Later, students will see 7×8 equals the well-remembered $7 \times 5 + 7 \times 3$, in preparation for learning about the distributive property. In the expression $x^2 + 9x + 14$, older students can see the 14 as 2×7 and the 9 as $2 + 7$. They recognize the significance of an existing line in a geometric figure and can use the strategy of drawing an auxiliary line for solving problems. They also can step back for an overview and shift perspective. They can see complicated things, such as some algebraic expressions, as single objects or as being composed of several objects. For example, they can see $5 - 3(x - y)^2$ as 5 minus a positive number times a square and use that to realize that its value cannot be more than 5 for any real numbers x and y.

CCSS.MATH.PRACTICE.MP8 - Look for and express regularity in repeated reasoning.
Mathematically proficient students notice if calculations are repeated, and look both for general methods and for shortcuts. Upper elementary students might notice when dividing 25 by 11 that they are repeating the same calculations over and over again, and conclude they have a repeating decimal. By paying attention to the calculation of slope as they repeatedly check whether points are on the line through (1, 2) with slope 3, middle school students might abstract the equation $(y - 2)/(x - 1) = 3$. Noticing the regularity in the way terms cancel when expanding $(x - 1)(x + 1)$, $(x - 1)(x^2 + x + 1)$, and $(x - 1)(x^3 + x2 + x + 1)$ might lead them to the general formula for the sum of a geometric series. As they work to solve a problem, mathematically proficient students maintain oversight of the process, while attending to the details. They continually evaluate the reasonableness of their intermediate results.

III. Scope & Sequence

Unit 1: Graph Theory **(6 weeks)**

Euler Paths
Euler Circuits
Eulerizing
Hamiltonian Paths
Hamiltonian Circuits
Digraph
Matrices

Unit 2: Trees **(6 weeks)**

Traveling Salesman Algorithm
Sorted Edges Algorithm
Counting Principle and Factorials
Nearest Neighbor
Spanning Trees
Kruskal's Algorithm

Unit 3: Planning and Scheduling (6 weeks)

Critical Path Analysis
Shortest Path/Minimum Project time
Earliest Start Time
Critical Path Project

Unit 4: Map Coloring **(4 weeks)**

Chromatic Number
Four Color Theorem
Vertex Coloring
Brook's Theorem

Unit 5: Cryptography and Coding: **(8 weeks)**

Logic and Truth Tables
Encryption
Cypher Text (Caesar Cipher, Enigma Machine, etc.)
Cryptology
Sherlock Holmes – Dancing Men
Zodiac

Unit 6: Election Theory : **(7 Weeks)**

Voting Theory
Majority

Plurality
Preferential Voting
Run-off/Sequential Run-off
Borda Count
Condorcet
Election Theory Project (Analyzing all methods in one set)

Unit 7: Statistical Analysis: (10 weeks)

Measures of Central Tendency
Scatter plots
Box and Whisker Plots
Stem and Leaf Plots
Circle Graphs
Bar Graphs
Normal Distribution
Standard Deviation
Probability
Statistical Data Project

Unit 8: Course/College Prep Review: (2 weeks) – If Time is available

Algebra Review
Algebra 2 Review
Trigonometry Review
Standardized Test Prep

IV. Unit Descriptions

Unit 1: Distributions of Data and Measures of Central Tendency

Enduring Understanding

1. Optimization is finding the best solution within given constraints.
2. Algorithms can effectively and efficiently be used to quantify and interpret discrete information.

Essential Questions

1. How can visual tools such as networks (vertex-edge graphs) be used to answer questions?
2. How can algorithmic thinking be used to solve problems?
3. How are charts, diagrams and/or graphs used to enhance conceptual learning and problem solving?

Learning Objectives

The students will be able to:

1. Use graphs to represent real world situations.
2. Determine whether a path, circuit, or neither exists in a graph.
3. Recognize complete graphs and the number of hamiltonian circuits.
4. Solve problems through matrix addition, subtraction, and multiplication.

Common Core State Standards

- HSN.VM.C.6 - Use matrices to represent and manipulate data.
- HSN.VM.C.7- Multiply matrices by scalars to produce new matrices.
- HSN.VM.C.8 -Add, subtract, and multiply matrices of appropriate dimensions.
- HSN.VM.C.9 -Understand that, unlike multiplication of numbers, matrix multiplication for square matrices is not a commutative operation, but still satisfies the associative and distributive properties.
- HSN.VM.C.10-Understand that the zero and identity matrices play a role in matrix addition and multiplication similar to the role of 0 and 1 in the real numbers. The determinant of a square matrix is nonzero if and only if the matrix has a multiplicative inverse.
- HSG.MG.A.3-Apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize cost; working with typographic grid systems based on ratios).

Suggested Activities/Modifications

Below is a list of suggested activities, modifications, accommodations, and enrichment opportunities. This includes, but is not limited to,:

1. Activities
    a. Worksheets – Practice on methods

   b. Graph Theory Exam – Multiple choice, short answer, and open-ended questions
   c. Graph Theory Project – Identifying Euler and Hamiltonian Paths and Circuits in real world situations. (Mail delivery, Snow Plowing, Holiday delivery vs. Regular time etc.)
2. English Language Learners.
   a. Students may use a bilingual dictionary.
   b. Read written instructions.
   c. Students may be provided with note organizers / study guides to reinforce key topics.
   d. Provide modified assessments when necessary.
   e. Student may complete assessments in alternate setting when requested.
3. Special Education/504 Students
   f. Students may be provided with note organizers / study guides to reinforce key topics.
   g. Extended time on assessments when needed.
   h. Preferred seating to be determined by student and teacher.
   i. Provide modified assessments when necessary.
   j. Student may complete assessments in alternate setting when requested.
   k. Establish a non-verbal cue to redirect student when not on task.
   l. Maintain strong teacher / parent communication.
4. Gifted and Talented Students.
   m. Provide enrichment activities to expand upon the curriculum.
   n. Use higher level questioning techniques in class and on assessments.

<u>New Jersey Core Curriculum Standards – Technology and Career Awareness, Exploration, and Preparation</u>

- See Technology & Career Readiness & 21st Century Skills Standards Curriculum Appendix

<u>Career Readiness Practices</u>

- CRP2. Apply appropriate academic and technical skills.
- CRP4. Communicate clearly and effectively and with reason.
- CRP6. Demonstrate creativity and innovation.
- CRP7. Employ valid and reliable research strategies.
- CRP8. Utilize critical thinking to make sense of problems and persevere in solving them.
- CRP11. Use technology to enhance productivity.

<u>Career & Technical Education Content Area: 21st Century Life and Careers Standards</u>

- 9.3.ST.2 Use technology to acquire, manipulate, analyze and report data.
- 9.3.ST-SM.4 Apply critical thinking skills to review information, explain statistical analysis, and to translate, interpret and summarize research and statistical data.
- 9.3.ST-SM.3 Analyze the impact that science and mathematics has on society.

Unit 2: Trees

Enduring Understanding

1. There are multiple algorithms for finding a solution.
2. There are a variety of methods to find an optimal solution to a Traveling Salesman Problem.
3. Identify, find, and utilize minimum spanning trees in real world problems
4. Algorithms can effectively and efficiently be used to quantify and interpret discrete information.

Essential Questions

1. How can you connect cities or lay cable lines using the least amount of material?
2. Why are tree diagrams used to represent real world situations?
3. How can the use of algorithmic thinking be used to solve problems?
4. What is the best way to solve this?
5. What is important about tree diagrams and other methods of counting?

Learning Objectives

The students will be able to:

1. Solve problems using the TSP Algorithm
2. Use multiple algorithms to solve real world problems.
3. Create trees to find the number of solutions to a given problem
4. Apply the counting principle and factorials in order to check a tree diagram.
5. Create spanning trees and apply Krushkal's algorithm in solving.

Common Core State Standards

- HSS.CP.B.9 Use permutations and combinations to compute probabilities of compound events and solve problems.
- HSS.MD.B.7 Analyze decisions and strategies using probability concepts
- HSG.MG.A.3-Apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize cost; working with typographic grid systems based on ratios).
- HSS.MD.B.7 Analyze decisions and strategies using probability concepts
- HSG.MG.A.3-Apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize cost; working with typographic grid systems based on ratios).

Suggested Activities/Modifications

Below is a list of suggested activities, modifications, accommodations, and enrichment opportunities. This includes, but is not limited to,:

1. Activities
    a. Trees Exam – Test using multiple choice, short answer and open-ended questions

   b. Worksheets – Demonstrating the differences and similarities between the algorithms
   c. Project – apply TSP, sorted edges and nearest neighbor in a real world travel situation
2. English Language Learners.
   a. Students may use a bilingual dictionary.
   b. Read written instructions.
   c. Students may be provided with note organizers / study guides to reinforce key topics.
   d. Provide modified assessments when necessary.
   e. Student may complete assessments in alternate setting when requested.
3. Special Education/504 Students
   f. Students may be provided with note organizers / study guides to reinforce key topics.
   g. Extended time on assessments when needed.
   h. Preferred seating to be determined by student and teacher.
   i. Provide modified assessments when necessary.
   j. Student may complete assessments in alternate setting when requested.
   k. Establish a non-verbal cue to redirect student when not on task.
   l. Maintain strong teacher / parent communication.
4. Gifted and Talented Students.
   m. Provide enrichment activities to expand upon the curriculum.
   n. Use higher level questioning techniques in class and on assessments.

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<u>Career & Technical Education Content Area: 21st Century Life and Careers Standards</u>

- 9.3.ST.2 Use technology to acquire, manipulate, analyze and report data.
- 9.3.ST-SM.4 Apply critical thinking skills to review information, explain statistical analysis, and to translate, interpret and summarize research and statistical data.
- 9.3.ST-SM.3 Analyze the impact that science and mathematics has on society.

Unit 3: Displaying Relationships and Regressional Analysis (5 days)

Enduring Understanding

1. Optimization is finding the best solution within given restraints
2. Algorithms can effectively and efficiently be used to represent discrete data
3. Improve efficiency through planning and scheduling techniques

Essential Question(s)

1. How can you solve problems such as providing services efficiently and on time?
2. How can graphs be used to represent real world scheduling situations?
3. How are charts, diagrams, and graphs used to enhance conceptual learning and problem solving?

Learning Objectives

The students will be able to:

1. Understand how individuals can improve efficiency and cost through planning and scheduling techniques and strategies.
2. Apply critical path analysis
3. Determine the earliest start time and therefore efficiency of a project
4. Apply their knowledge of critical path analysis in a real world setting during their "warehouse project"

Common Core State Standards

- HSG.MG.A.3-Apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize cost
- HSF.IF.B.5-Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. *For example, if the function h(n) gives the number of person-hours it takes to assemble n engines in a factory, then the positive integers would be an appropriate domain for the function.*
- CCSS.MP1-Make sense of problems and persevere in solving them
- CCSS.MP4 - Model with mathematics and identify important quantities in a practical situation and map their relationships using such tools as diagrams

Suggested Activities/Modifications

Below is a list of suggested activities, modifications, accommodations, and enrichment opportunities. This includes, but is not limited to,:

1. Activities
    a. Worksheets – Practice methods
    b. Exam – Multiple Choice, Short answer and Open Ended questions
    c. Project – "Celebrity Apprentice" Project managers assigned to complete tasks in a real world, fast paced business venture.
2. English Language Learners.
    a. Students may use a bilingual dictionary.

   b. Read written instructions.
   c. Students may be provided with note organizers / study guides to reinforce key topics.
   d. Provide modified assessments when necessary.
   e. Student may complete assessments in alternate setting when requested.
3. Special Education/504 Students
   a. Students may be provided with note organizers / study guides to reinforce key topics.
   b. Extended time on assessments when needed.
   c. Preferred seating to be determined by student and teacher.
   d. Provide modified assessments when necessary.
   e. Student may complete assessments in alternate setting when requested.
   f. Establish a non-verbal cue to redirect student when not on task.
   g. Maintain strong teacher / parent communication.
4. Gifted and Talented Students.
   a. Provide enrichment activities to expand upon the curriculum.
   b. Use higher level questioning techniques in class and on assessments.

<u>New Jersey Core Curriculum Standards – Technology and Career Awareness, Exploration, and Preparation</u>

- See Technology & Career Readiness & 21st Century Skills Standards Curriculum Appendix

<u>Career Readiness Practices</u>

- CRP2. Apply appropriate academic and technical skills.
- CRP4. Communicate clearly and effectively and with reason.
- CRP6. Demonstrate creativity and innovation.
- CRP7. Employ valid and reliable research strategies.
- CRP8. Utilize critical thinking to make sense of problems and persevere in solving them.
- CRP11. Use technology to enhance productivity.

<u>Career & Technical Education Content Area: 21st Century Life and Careers Standards</u>

- 9.3.ST.2 Use technology to acquire, manipulate, analyze and report data.
- 9.3.ST-SM.4 Apply critical thinking skills to review information, explain statistical analysis, and to translate, interpret and summarize research and statistical data.
- 9.3.ST-SM.3 Analyze the impact that science and mathematics has on society.

Unit 4: Map Coloring

<u>Enduring Understanding</u>

1. Applying vertex coloring to solve real world application
2. Applying the Four Colour Theorem to solve real world problems
3. Identifying conflict resolutions through coloring algorithms and theorems.

Essential Question(s)

1. How can you use coloring methods to solve problems in the real world?
2. How can attributes be used to classify data?
3. How can conflicts be identified and solved using coloring theorems and strategies?

Learning Objectives

The students will be able to:

1. Identify the chromatic number of a diagram
2. Resolve conflicts through vertex coloring
3. Establish committees through coloring
4. Apply brook's theorem in conflict resolution situations

Common Core State Standards

- CCSS.MP1-Make sense of problems and persevere in solving them
- CCSS.MP4 - Model with mathematics and identify important quantities in a practical situation and map their relationships using such tools as diagrams
- HSN.Q.A.3-Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.

Suggested Activities/Modifications

Below is a list of suggested activities, modifications, accommodations, and enrichment opportunities. This includes, but is not limited to,:

1. Activities
    a. Worksheets – Practice on methods and application of Theorems.
    b. Graph Theory Exam – Multiple Choice, short answer, and open ended
    c. Graph theory project – Applying knowledge of algorithms to help in conflict resolution
2. English Language Learners.
    a. Students may use a bilingual dictionary.
    b. Read written instructions.
    c. Students may be provided with note organizers / study guides to reinforce key topics.
    d. Provide modified assessments when necessary.
    e. Student may complete assessments in alternate setting when requested.
3. Special Education/504 Students
    a. Students may be provided with note organizers / study guides to reinforce key topics.
    b. Extended time on assessments when needed.
    c. Preferred seating to be determined by student and teacher.
    d. Provide modified assessments when necessary.
    e. Student may complete assessments in alternate setting when requested.

f. Establish a non-verbal cue to redirect student when not on task.
g. Maintain strong teacher / parent communication.

4. Gifted and Talented Students.
   a. Provide enrichment activities to expand upon the curriculum.
   b. Use higher level questioning techniques in class and on assessments.

New Jersey Core Curriculum Standards – Technology and Career Awareness, Exploration, and Preparation

- See Technology & Career Readiness & 21st Century Skills Standards Curriculum Appendix

Career Readiness Practices

- CRP1. Act as a responsible and contributing citizen and employee.
- CRP2. Apply appropriate academic and technical skills.
- CRP4. Communicate clearly and effectively and with reason.
- CRP6. Demonstrate creativity and innovation.
- CRP7. Employ valid and reliable research strategies.
- CRP8. Utilize critical thinking to make sense of problems and persevere in solving them.
- CRP11. Use technology to enhance productivity.

Career & Technical Education Content Area: 21st Century Life and Careers Standards

- 9.3.ST.2 Use technology to acquire, manipulate, analyze and report data.
- 9.3.ST-SM.4 Apply critical thinking skills to review information, explain statistical analysis, and to translate, interpret and summarize research and statistical data.
- 9.3.ST-SM.3 Analyze the impact that science and mathematics has on society.

Unit 5: Cryptography and Coding

Enduring Understanding

1. Problem solving depends on making wise choices and applying deductive reasoning
2. There are multiple procedures and algorithms to analyze encryption
3. Alphabetical data can be configured through mathematics in many ways

Essential Question(s)

1. Why are codes important in society?
2. How is logic used in everyday life?
3. How is deductive reasoning applied in cryptography?

What makes a computational strategy both efficient and effective in cryptography?

Learning Objectives

Students will be able to:

1. Break codes through cipher text and encryption.
2. Identify the importance of encryption and code cracking through historical events.
3. Create codes through cipher text

4. Solve basic logic problems
5. Create truth tables

Common Core State Standards

- MP3 Construct viable arguments and critique the reasoning of others.
- MP4 Model with mathematics
- MP5 Use appropriate tools strategically
- MP8 Look for and express regularity in repeated reasoning.

Suggested Activities/Modifications

Below is a list of suggested activities, modifications, accommodations, and enrichment opportunities. This includes, but is not limited to,:

1. Activities
    a. FBI activity – Cracking/investigating historical codes and understanding their role in history. (Caesar cipher, enigma machine, Rosetta stone etc.)
    b. Exam – Multiple choice, short answer, open ended
    c. Worksheets – practice on cipher text and encryption
2. English Language Learners.
    a. Students may use a bilingual dictionary.
    b. Read written instructions.
    c. Students may be provided with note organizers / study guides to reinforce key topics.
    d. Provide modified assessments when necessary.
    e. Student may complete assessments in alternate setting when requested.
3. Special Education/504 Students
    a. Students may be provided with note organizers / study guides to reinforce key topics.
    b. Extended time on assessments when needed.
    c. Preferred seating to be determined by student and teacher.
    d. Provide modified assessments when necessary.
    e. Student may complete assessments in alternate setting when requested.
    f. Establish a non-verbal cue to redirect student when not on task.
    g. Maintain strong teacher / parent communication.
4. Gifted and Talented Students.
    a. Provide enrichment activities to expand upon the curriculum.
    b. Use higher level questioning techniques in class and on assessments.

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Career Readiness Practices

- CRP2. Apply appropriate academic and technical skills.
- CRP4. Communicate clearly and effectively and with reason.
- CRP6. Demonstrate creativity and innovation.
- CRP7. Employ valid and reliable research strategies.
- CRP8. Utilize critical thinking to make sense of problems and persevere in solving them.
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- 9.3.ST-SM.3 Analyze the impact that science and mathematics has on society.

Unit 6: Theory

Enduring Understanding

1. The message conveyed by the data depends on how data is collected, represented, and summarized.
2. The result of a statistical investigation can be used to support or refute an argument.
3. Fair Division is a critical procedure in each situation
4. Understanding how a group of individuals, with their own set of values can select one outcome from a list of possibilities

Essential Question(s)

1. How can the collection, organization, interpretation, and display of data be used to answer questions and be used to predict future events?
2. How can you determine a winner using a variety of methods?
3. How can an election be considered fair when determining a winner under a variety of methods?
4. How do we rank or elect the best choice of a group?

Learning Objectives

The students will be able to:

1. Determine a "winner" through Majority, Plurality, Borda count, Run-off, Sequencial Run-off, and Condorcet method.
2. Measure voter's power.
3. Fairly divide a set of objects among a specified number of players.
4. Determine if an election is fair.
5. Understand how weighted voting works in real world situations.

Common Core State Standards

- HSS.IC.B.3- Recognize the purposes of and differences among sample surveys, experiments, and observational studies; explain how randomization relates to each.

- HSS.IC.B.4-Use data from a sample survey to estimate a population mean or proportion; develop a margin of error through the use of simulation models for random sampling.
- HSS.IC.B.5-Use data from a randomized experiment to compare two treatments; use simulations to decide if differences between parameters are significant.
- HSS.IC.B.6-Evaluate reports based on data
- MP.1- Make sense of problems and persevere in solving them
- MP.3 -Construct viable arguments and critique the reasoning of others
- MP.5 -Use appropriate tools strategically.

Suggested Activities/Modifications

Below is a list of suggested activities, modifications, accommodations, and enrichment opportunities. This includes, but is not limited to,:

1. Activities
    a. Exam – Multiple Choice, Short answer, open ended
    b. Project – Demonstrating all methods in one given set
    c. Worksheets – Practice on each method
2. English Language Learners.
    a. Students may use a bilingual dictionary.
    b. Read written instructions.
    c. Students may be provided with note organizers / study guides to reinforce key topics.
    d. Provide modified assessments when necessary.
    e. Student may complete assessments in alternate setting when requested.
3. Special Education/504 Students
    a. Students may be provided with note organizers / study guides to reinforce key topics.
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    c. Preferred seating to be determined by student and teacher.
    d. Provide modified assessments when necessary.
    e. Student may complete assessments in alternate setting when requested.
    f. Establish a non-verbal cue to redirect student when not on task.
    g. Maintain strong teacher / parent communication.
4. Gifted and Talented Students.
    a. Provide enrichment activities to expand upon the curriculum.
    b. Use higher level questioning techniques in class and on assessments.

New Jersey Core Curriculum Content Standards - Technology

- See Technology & Career Readiness & 21st Century Skills Standards Curriculum Appendix

Career Readiness Practices

- CRP1. Act as a responsible and contributing citizen and employee.

- CRP2. Apply appropriate academic and technical skills.
- CRP3. Attend to personal health and financial well-being.
- CRP4. Communicate clearly and effectively and with reason.
- CRP5. Consider the environmental, social and economic impacts of decisions.
- CRP6. Demonstrate creativity and innovation.
- CRP7. Employ valid and reliable research strategies.
- CRP8. Utilize critical thinking to make sense of problems and persevere in solving them.
- CRP9. Model integrity, ethical leadership and effective management.
- CRP10. Plan education and career paths aligned to personal goals.
- CRP11. Use technology to enhance productivity.
- CRP12. Work productively in teams while using cultural global competence.

9.2 Career Awareness, Exploration, and Preparation Content Area: 21st Century Life and Careers
Strand C: Career Preparation

- 9.2.12.C.6 – Investigate entrepreneurship opportunities as options for career planning and identify the knowledge, skills, abilities, and resources required for owning and managing a business.
- 9.2.12.C.7 – Examine the professional, legal, and ethical responsibilities for both employers and employees in the global workplace.

Career & Technical Education Content Area: 21st Century Life and Careers Standards

- 9.3.ST.2 Use technology to acquire, manipulate, analyze and report data.
- 9.3.ST-SM.4 Apply critical thinking skills to review information, explain statistical analysis, and to translate, interpret and summarize research and statistical data.
- 9.3.ST-SM.3 Analyze the impact that science and mathematics has on society.

Unit 7: Statistical Analysis

Enduring Understanding

1. A quantity can be represented numerically in various ways.
2. Problem solving depends greatly upon wise choices.
3. Computational fluency includes understanding the meaning and appropriate use of numerical operations
4. Various sampling techniques can justify data and outcomes in statistical analysis

Essential Question(s)

1. What are measure of central tendency and which graphs help show those measures?
2. How can we apply the empirical rule for normally distributed data sets to approximate percentages and percentiles?
3. Which graphs help represent specific types of data?
4. How do mathematical representations reflect the needs of society?
5. What makes a computational strategy both effective and efficient?

6. What is the best way to represent this data?
7. What is important in designing an experiment?
8. What is important about probability in real world situations?

Learning Objectives

The students will be able to:

1. Create scatterplots, box and whiskers, histograms, circle graphs and stem and leaf plots.
2. Read data represented in statistical plots.
3. Understand the empirical rule.
4. Understand how mathematical models can be used to analyze real world data.
5. Design an experiment and test the hypothesis.
6. Work with the basic rules of probability

Common Core State Standards

- HSS.IC.B.3 Recognize the purposes of and differences among sample surveys, experiments, and observational studies; explain how randomization relates to each.
- HSS.CP.A.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.
- HSS.CP.B.9 Use permutations and combinations to compute probabilities of compound events and solve problems.
- HSS.MD.A.2 Calculate the expected value of a random variable; interpret it as the mean of the probability distribution.
- HSS.MD.A.3 Develop a probability distribution for a random variable defined for a sample space in which theoretical probabilities can be calculated; find the expected value.
- HSS.MD.A.4 Develop a probability distribution for a random variable defined for a sample space in which probabilities are assigned empirically; find the expected value
- HSS.ID.A.1Represent data with plots on the real number line (dot plots, histograms, and box plots).
- HSS.ID.A.2 Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets.

Suggested Activities/Modifications

Below is a list of suggested activities, modifications, accommodations, and enrichment opportunities. This includes, but is not limited to,:

1. Activities
    a. Exam – Multiple Choice, Short answer, Open ended
    b. Project – representing data in multiple plots, creating questions on reading the data and how it can be misleading.
    c. Worksheets – Practice on normal distribution, empirical rule etc…

   d. Worksheets – Outlining the use of empirical rule and skewed data in real world situations.

2. English Language Learners.
   a. Students may use a bilingual dictionary.
   b. Read written instructions.
   c. Students may be provided with note organizers / study guides to reinforce key topics.
   d. Provide modified assessments when necessary.
   e. Student may complete assessments in alternate setting when requested.
3. Special Education/504 Students
   a. Students may be provided with note organizers / study guides to reinforce key topics.
   b. Extended time on assessments when needed.
   c. Preferred seating to be determined by student and teacher.
   d. Provide modified assessments when necessary.
   e. Student may complete assessments in alternate setting when requested.
   f. Establish a non-verbal cue to redirect student when not on task.
   g. Maintain strong teacher / parent communication.
4. Gifted and Talented Students.
   a. Provide enrichment activities to expand upon the curriculum.
   b. Use higher level questioning techniques in class and on assessments.

<u>New Jersey Core Curriculum Content Standards - Technology</u>

- See Technology & Career Readiness & 21st Century Skills Standards Curriculum Appendix

<u>Career Readiness Practices</u>

- CRP1. Act as a responsible and contributing citizen and employee.
- CRP2. Apply appropriate academic and technical skills.
- CRP3. Attend to personal health and financial well-being.
- CRP4. Communicate clearly and effectively and with reason.
- CRP5. Consider the environmental, social and economic impacts of decisions.
- CRP6. Demonstrate creativity and innovation.
- CRP7. Employ valid and reliable research strategies.
- CRP8. Utilize critical thinking to make sense of problems and persevere in solving them.
- CRP9. Model integrity, ethical leadership and effective management.
- CRP10. Plan education and career paths aligned to personal goals.
- CRP11. Use technology to enhance productivity.
- CRP12. Work productively in teams while using cultural global competence.

<u>9.2 Career Awareness, Exploration, and Preparation Content Area: 21st Century Life and Careers Strand C: Career Preparation</u>

- 9.2.12.C.3 – Identify transferable career skills and design alternate career plans.
- 9.2.12.C.6 – Investigate entrepreneurship opportunities as options for career planning and identify the knowledge, skills, abilities, and resources required for owning and managing a business.
- 9.2.12.C.7 – Examine the professional, legal, and ethical responsibilities for both employers and employees in the global workplace.
- *9.2.12.C.9 – Analyze the correlation between personal and financial behavior and employability*

Career & Technical Education Content Area: 21st Century Life and Careers Standards

- 9.3.ST.2 Use technology to acquire, manipulate, analyze and report data.
- 9.3.ST-SM.4 Apply critical thinking skills to review information, explain statistical analysis, and to translate, interpret and summarize research and statistical data.
- 9.3.ST-SM.3 Analyze the impact that science and mathematics has on society.

V. Course Materials

MATERIALS

1.Textbooks

For All Practical Purposes
ISBN # 0-7167-2841-9
Freeman (COMAP., 1997
Discrete Math through Applications
ISBN # 0-7167-2577-0
Freeman (COMAP., 1998

2. Text Support
Instructor's Guide

For All Practical Purposes

Transparency Masters
CD-ROM
Discrete Math through Applications
Instructor's Manual
Test Bank

3. Teacher References

Materials Obtained from Rutgers University

"Crash Course" Summer 1998 Workshop
Various Discrete Math Websites:
The Math Forum
http://www.forum.swarthmore.edu

Mega Math
http://www.c3.lanl.gov/mega-math
The Discrete Math Project

http://www.colorado.edu/education/DMP
COMAP
http://www.comap.com

4. Calculators
5. Maps
6. Poster Paper
7. Crayons/Color Pencils
8. Computers

VI. Assessments

1. Unit Exams
2. Midterms
3. Final Exams

4. Unit Projects

VII. Cross Curricular Aspects

1. History -In Unit 5 we will be discussing the importance of coding and code cracking throughout history. We will cover topics from Julius Caesar all the way to the Zodiac Killer. The historical background will help show how cipher text has evolved.
2. English-In Unit 5 we will read Sherlock Holmes – "Dancing Men" to note cryptography in literature.
3. In Unit 7 we will be representing data using multiple graphs. This will represent marketing tools to demonstrate misleading graphs as well as marketing strategies to promote one's product or cause. This will demonstrate mathematics in business.