Orange Public Schools

Office of Curriculum & Instruction
2020-2021 Mathematics Curriculum Guide

Introduction to Statistics

Unit 3: Statistical Inference

February 8, 2021 – April 30, 2021

Board Approved: 1.14.2020

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Contents

Curriculum Map

A STORY OF UNITS (Yearlong Pacing Guide)				
Marking Period	**Unit 1** (9/9/20 – 11/13/20)	**Unit 2** (11/14/20- 2/07/21)	**Unit 3** (2/08/21-4/30/10)	**Unit 4** (5/1/21-6/22/21)
Unit Topic	**Descriptive Statistics**	**Probability**	**Statistical Inference**	**More Statistical inference:**
Description	Distinguish between qualitative data and quantitative data Classify data with respect to the four levels of measurement: nominal, ordinal, interval, and ratio Compare Descriptive and Inferential Statistics Distinguish between parameter and statistics Create frequency Distribution, Histogram, Pareto Chart, Pie chart, Bar graph, Stem and Leaf, Dot plots. Compute measure of central tendency, Compute range, standard deviation, variance, Compute mean and standard deviation of grouped data, Compute	Basic concept of probability and counting, Conditional probability and the multiplication rule, Understand and apply Permutation and Combination Understand probability distribution, Identify and apply binomial distribution, Understand and use Poisson distribution Introduction to normal distribution and standard normal distribution Finding probability and values from normal distribution,	Confidence interval for the mean of large sample and small sample Confidence Interval for population proportion Confidence interval for variance and standard deviation Introduction to Hypothesis testing, Hypothesis testing for the mean of large and small sample, Hypothesis testing for proportion, Hypothesis testing for variance and standard devition	Testing the difference between means of large and small Independent samples Testing the difference between means dependent samples Testing the difference between proportions Find correlation and Linear regression Measure of regression and prediction interval use the chi-square distribution to test whether a frequency distribution fits a claimed distribution use a contingency table to find expected frequencies use a chi-square distribution to test whether two variables are independent

	weighted average, Understand and apply empirical rule, compute and interpret z score Create box whisker plot and interpret.	Understand and apply sampling distribution and central limit theorem		Interpret the F-distribution and use an F-table to find critical values perform a two-sample F-test to compare two variances

Unit Overview

Unit 3: Statistical inference: Confidence interval and Hypothesis testing

Essential Questions

- How much evidence do you need before you are able to make a reasonable conjecture?
- Is it reasonable to think that different people require different amounts of convincing?
- How is statistical inference used to draw conclusions from data?
- How do you interpret confidence intervals? How do you not interpret them?
- How much evidence do you need before you are able to make a reasonable conjecture?
- Is it reasonable to think that different people require different amounts of convincing?
- How is statistical inference used to draw conclusions from data?
- How do you interpret confidence intervals? How do you not interpret them?

Enduring Understandings

- Statistical inference guides the selection of appropriate models. .
- Confidence intervals are effective tools for estimation.
- Tests of significance and confidence intervals drive decision making in our world.
- Error analysis is a critical component of significance testing.
- Significance tests determine the likelihood of a sample. The analysis is only as good as the data.

NJSLS

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. *For example, find a current data distribution on the number of TV sets per household in the United States, and calculate the expected number of sets per household. How many TV sets would you expect to find in 100 randomly selected households?*

.HSS.MD.B.6
Use probabilities to make fair decisions (e.g., drawing by lots, using a random number generator).

HSS.MD.B.7
Analyze decisions and strategies using probability concepts (e.g., product testing, medical testing, pulling a hockey goalie at the end of a game).

Algebra 1 Unit 3

Student Learning Material

Student Learning Material
Course: Elementary Statistics Picturing the world , 5TH Edition, Ron Larson and Betsy Farber http://doverdhs.ss5.sharpschool.com/UserFiles/Servers/Server_7591927/File/[Larson-Farber]%20Elementary%20Statistics.%20Picturing%20the%20World.pdf Useful Sites: http://www.100people.org/statistics_detailed_statistics.php http://learningtogive.org/lessons/unit137/lesson3.html http://www.gapminder.org/videos/the-joy-of-stats/ - video http://nationalatlas.gov/articles/mapping/a_statistics.html http://serc.carleton.edu/sp/cause/conjecture/examples/18164.html Data: http://www.census.gov/main/www/access.html http://www.cdc.gov/datastatistics/ Other Textbook: http://www.artofproblemsolving.com/LaTeX/Examples/statistics_firstfive.pdf There are 10 chapters and four units in the text book. Unit 3 Consist of chapter 6 and Chapter 7. In chapter 6 students will: Interpret a confidence level in context. Interpret a confidence interval in context. Understand that a confidence interval gives a range of plausible values for the parameter. Understand why each of the three inference conditions—Random, Normal, and Independent—is important. In chapter 7 students will: State correct hypotheses for significance test about a population proportion or mean. Interpret a Type I error and a Type II error in context, and give the consequences of each. Understand the relationship between the significance level of a test, ***p*** (Type II error), and power. Check conditions for carrying out a test about a population proportion. If conditions are met, conduct a significance test about a population proportion. If conditions are met, conduct a one-sample ***t***- test about a population mean μ .

Modifications

Modifications

Special Education/ 504:	English Language Learners:
-Adhere to all modifications and health concerns stated in each IEP. -Give students a MENU options, allowing students to pick assignments from different levels based on difficulty. -Accommodate Instructional Strategies: reading aloud text, graphic organizers, one-on-one instruction, class website (Google Classroom), handouts, definition list with visuals, extended time -Allow students to demonstrate understanding of a problem by drawing the picture of the answer and then explaining the reasoning orally and/or writing , such as Read-Draw-Write -Provide breaks between tasks, use positive reinforcement, use proximity -Assure students have experiences that are on the Concrete- Pictorial- Abstract spectrum by using manipulatives -Common Core Approach to Differentiate Instruction: Students with Disabilities (pg 17-18) -Strategies for Students with 504 Plans	- Use manipulatives to promote conceptual understanding and enhance vocabulary usage - Provide graphic representations, gestures, drawings, equations, realia, and pictures during all segments of instruction - During ALEKS lessons, click on “Español” to hear specific words in Spanish - Utilize graphic organizers which are concrete, pictorial ways of constructing knowledge and organizing information - Use sentence frames and questioning strategies so that students will explain their thinking/ process of how to solve word problems - Utilize program translations (if available) for L1/ L2 students - Reword questions in simpler language - Make use of the ELL Mathematical Language Routines (click here for additional information) -Scaffolding instruction for ELL Learners -Common Core Approach to Differentiate Instruction: Students with Disabilities (pg 16-17)
Gifted and Talented:	**Students at Risk for Failure:**
- Elevated contextual complexity - Inquiry based or open ended assignments and projects - More time to study concepts with greater depth - Promote the synthesis of concepts and making real world connections - Provide students with enrichment practice that are imbedded in the curriculum such as: ● Application / Conceptual Development ● Are you ready for more? - Common Core Approach to Differentiate Instruction: Students with Disabilities (pg. 20)	- Assure students have experiences that are on the Concrete- Pictorial- Abstract spectrum - Modify Instructional Strategies, reading aloud text, graphic organizers, one-on-one instruction, class website (Google Classroom), inclusion of more visuals and manipulatives, Field Trips, Google Expeditions, Peer Support, one on one instruction - Assure constant parental/ guardian contact throughout the year with successes/ challenges - Provide academic contracts to students and guardians - Create an interactive notebook with samples, key vocabulary words, student goals/ objectives.

- Provide opportunities for math competitions - Alternative instruction pathways available	- Always plan to address students at risk in your learning tasks, instructions, and directions. Try to anticipate where the needs will be and then address them prior to lessons. -Common Core Approach to Differentiate Instruction: Students with Disabilities (pg 19)

21st Century Life and Career Skills

21st Century Life and Career Skills:

Career Ready Practices describe the career-ready skills that all educators in all content areas should seek to develop in their students. They are practices that have been linked to increase college, career, and life success. Career Ready Practices should be taught and reinforced in all career exploration and preparation programs with increasingly higher levels of complexity and expectation as a student advances through a program of study.

https://www.state.nj.us/education/cccs/2014/career/9.pdf

• **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.
Students are given an opportunity to communicate with peers effectively, clearly, and with the use of technical language. They are encouraged to reason through experiences that promote critical thinking and emphasize the importance of perseverance. Students are exposed to various mediums of technology, such as digital learning, calculators, and educational websites.	

Technology Standards

Technology Standards: All students will be prepared to meet the challenge of a dynamic global society in which they participate, contribute, achieve, and flourish through universal access to people, information, and ideas. https://www.state.nj.us/education/cccs/2014/tech/	
8.1 Educational Technology: All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and to create and communicate knowledge.	**8.2 Technology Education, Engineering, Design, and Computational Thinking - Programming:** All students will develop an understanding of the nature and impact of technology, engineering, technological design, computational thinking and the designed world as

A. **Technology Operations and Concepts:** Students demonstrate a sound understanding of technology concepts, systems and operations. B. **Creativity and Innovation:** Students demonstrate creative thinking, construct knowledge and develop innovative products and process using technology. C. **Communication and Collaboration:** Students use digital media and environments to communicate and work collaboratively, including at a distance, to support individual learning and contribute to the learning of others. D. **Digital Citizenship:** Students understand human, cultural, and societal issues related to technology and practice legal and ethical behavior. E. **Research and Information Fluency:** Students apply digital tools to gather, evaluate, and use of information. F. **Critical thinking, problem solving, and decision making:** Students use critical thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources.	they relate to the individual, global society, and the environment. A. **The Nature of Technology: Creativity and Innovation-** Technology systems impact every aspect of the world in which we live. B. **Technology and Society:** Knowledge and understanding of human, cultural, and societal values are fundamental when designing technological systems and products in the global society. C. **Design:** The design process is a systematic approach to solving problems. D. **Abilities in a Technological World:** The designed world in a product of a design process that provides the means to convert resources into products and systems. E. **Computational Thinking: Programming-** Computational thinking builds and enhances problem solving, allowing students to move beyond using knowledge to creating knowledge.

Interdisciplinary Connections

Interdisciplinary Connections:	
English Language Arts:	
ELA.LITERACY.RI-9-10.4	Determine the meaning of words and phrases as they are used in a text, including figurative, connotative, and technical meanings; analyze the cumulative impact of specific word choices on meaning and tone (e.g., how the language of a court opinion differs from that of a newspaper).

NJSLS.ELA-LITERACY.SL.9-10.4	Present information, findings, and supporting evidence clearly, concisely, and logically such that listeners can follow the line of reasoning and the organization, development, substance, and style are appropriate to purpose, audience, and task.
NJSLS.ELA-LITERACY.W.9-10.2.A	Introduce a topic; organize complex ideas, concepts, and information to make important connections and distinctions; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension.

Pacing Guide

Overview		
Lesson	Topic	Suggesting Pacing
6.1	Confidence Interval for the mean (Large Sample)	3 days
6.2	Confidence Interval for the mean (Small Sample)	2 days
6.3	Confidence interval for the population proportion	3 days
6.4	Confidence interval for variance and standard deviation	3 days
6.5	Review	2 days
	Chapter 6 test	1 day
7.1	Introduction to Hypothesis testing	2 days
7.2	Hypothesis testing for the mean (Large Sample)	3 days
7.3	Hypothesis testing for the mean (Small Sample)	2 days
7.4	Hypothesis testing for the proportion	3 days
7.5	Hypothesis testing for the Variance and Standard Deviation	3 days

Algebra 1 Unit 3

7.6	Review	2 days
	Chapter 7 test	1 day

Summary:

24 days on new content (9 lessons/topics)
2 task days
4 review day
4 quiz days
2 test day
2 Days Benchmark Assessment

38 days in Unit 3

Calendar

Please fill out the pacing calendar based on the pacing guide

February 2021						
Sun	**Mon**	**Tue**	**Wed**	**Thu**	**Fri**	**Sat**

Algebra 1 Unit 3

February 2021						
Sun	Mon	Tue	Wed	Thu	Fri	Sat
2						
9						
16						
23						

Algebra 1 Unit 3

March 2021						
Sun	Mon	Tue	Wed	Thu	Fri	Sat

Algebra 1 Unit 3

April 2021						
Sun	Mon	Tue	Wed	Thu	Fri	Sat

Assessment Framework

Assessment	Estimated Time	Format	Graded
Quizzes (3 to 4)	1/2 period per quiz	Individual	No
Chapter tests (2 tests)	1 period per test	Individual	Yes
Authentic assessment	TBD	Individual	Yes
Mp2 Benchmark Assessment (Part A and B)	2 periods	Individual	Yes
Assessment check points (exit tickets)	5-10 minutes	Individual	Varies

MP3 Benchmark Window: 3/29/2021 – 4/16/2021

Algebra 1 Unit 3

Chapter 6 Analysis

Skills/Knowledge/Understandings:

1. Understandings:
2. Statistical inference guides the selection of appropriate models. .
3. Confidence intervals are effective tools for estimation.
4. Tests of significance and confidence intervals drive decision making in our world.
5. Error analysis is a critical component of significance testing.

Learning Targets:

1. Understand how the margin of error of a confidence interval changes with the sample size and the level of confidence.
2. Find a point estimate and a margin of error.
3. Construct and interpret confidence intervals for the population mean ; determine the minimum sample size required when estimating Population mean
4. Interpret the t-distribution and use a t-distribution table;
5. Construct confidence intervals when the population is normally distributed, and is unknown
6. Find a point estimate for a population proportion; construct a confidence interval for a population proportion
7. Determine the minimum sample size required when estimating a population proportion
8. Interpret the chi-square distribution and use a chi-square distribution table
9. Use the chi-square distribution to construct a confidence interval for the variance and standard deviation

Objectives:

- Using a point estimate and margin of error, SWBAT construct and interpret confidence intervals for the population mean, as shown by correctly answering at least 3 / 4 classwork questions.
- Using the t-distribution, SWBAT construct confidence intervals when n<30, the population is normal distributed, and standard deviation is unknown, as shown by correctly constructing at least 3 / 4 small sample confidence intervals.
- Using a point estimate, SWBAT construct a confidence interval for a population proportion, as shown by correctly constructing at least 3 / 4 confidence intervals for populations.

Assessments:

Formative:	Summative:	Authentic:
a. Exit Slip (constructing confidence intervals for various sample sizes – less than 30, greater than or equal to 30). b. - 3-2-1 Writing (3 things I learned, 2 examples, 1 question I have)	a. Confidence Intervals Unit Test Example  Confidence Intervals Unit Test.doc	a. Students will be split into two teams: each team has to create 4 of their own confidence interval problems (based on 4 types), and solve. Each team will present 1 problem / solution to the class. Problems will cover Sections 6.1-6.3, and will be written on poster paper. Presentations will be graded on accuracy of problem, presentation skills (volume, clarity, each person participating), and effort.

Literacy Connections:

Math Literacy – Students should be able to make estimations, and clearly describe their confidence level / margin of error (including causes of error). They should be able to interpret the confidence intervals they create by referring to the real-world context of given problems.

Interdisciplinary Connections:

Margin of Error and Confidence Intervals are used in Science, Engineering, and Medical courses, as well as in the news / social media / etc. Students should be exposed to these real-world applications and examples.

Algebra 1 Unit 3

Technology Integration: Applets: http://www.math.usu.edu/~schneit/CTIS/CI/ http://www.amstat.org/publications/jse/v6n3/applets/confidenceinterval.html TI-84 Calc: http://education.ti.com/en/us/activity/detail?id=35C3919B98DA4FEE8963AF5658C36603
Key Vocabulary: Confidence Level Confidence Interval Population Proportion Margin of Error
Useful Sites: AP Stats: http://apcentral.collegeboard.com/apc/members/courses/teachers_corner/21968.html  Stats_Confidence Intervals Raison Activ

Algebra 1 Unit 3

Chapter 7 Analysis

Skills/Knowledge/Understandings:
Understandings:

1. Significance tests determine the likelihood of a sample.
2. The analysis is only as good as the data.

Learning Targets:

1. State a null hypothesis and an alternative hypothesis
2. Identify type I and type II errors and interpret the level of significance; know whether to use a one-tailed or two-tailed statistical test and find a P-value; make and interpret a decision based on the results of a statistical test ;
3. Write a claim for a hypothesis test; How to find P-values and use them to test a mean ; use P-values for a z-test
4. Find critical values and rejection regions in a normal distribution
5. Use rejection regions for a z-test, find critical values in a t-distribution
6. Use the t-test to test a mean ,use technology to find P-values and use them with a t-test to test a mean

Objectives:

- Using definitions of null and alternative hypotheses and Type I and Type II errors, SWBAT use a one-tailed and two-tailed statistical test to write a claim
- Using hypothesis test definitions, SWBAT make and interpret a decision based on the results of a statistical test
- Using t-distribution critical values, SWBAT use the t-test to test a mean
- Using a z-test, SWBAT test a population proportion

Assessments:

Formative:	Summative:	Authentic:
Classwork Problems: pg. 367: 11, 21, 23, 25, 29, 35, 37 M&Ms activity graphic organizer: hypothesis test of M&Ms bags Two-Sides: two sides of room represent reject null hypothesis or fail to reject null hypothesis (check student understanding for various situations)	Hypothesis Testing Unit Test Example  Hypothesis Testing Test.doc	Hypothesis Testing Project Example  Hyp Test Proj.doc

Literacy Connections:
Math Literacy – Students should be able to test whether or not a claim is accurate, and be able to interpret the results in a real-world context. Students should use correct language for decision / interpretation (reject null hypothesis / claim, fail to reject null hypothesis / claim)

Interdisciplinary Connections:
Tests of hypotheses are performed in more advanced science courses, and can be applied to many additional subjects and real-world topics. Students are exposed to claims through the media, news, etc., and can test these claims using hypothesis testing.

Technology Integration:
Applets:
http://www.amstat.org/publications/jse/v6n3/applets/power.html
http://www.amstat.org/publications/jse/v16n3/schneiter.html
TI-84 Calc:
http://education.ti.com/en/timath/us/detail?id=23C4CF41C0EB47088F0F8F8087B02240&sa=44D0E51546AF420EA579740D43F22FC7

Key Vocabulary:
Null Hypothesis
Alternative Hypothesis
Reject vs. Fail to Reject
Claim

Algebra 1 Unit 3

Type I Error Type II Error Level of Significance P-Value
Useful Sites: AP Stats: http://apcentral.collegeboard.com/apc/members/courses/teachers_corner/22815.html http://apcentral.collegeboard.com/apc/public/repository/AP_Statistics_Teacher_Guide.pdf (Inference for Proportions Activity) Significance of a Kiss Activity: https://www.causeweb.org/repository/StarLibrary/activities/richardson_curtiss_gabrosek2002/

5 Practices for Orchestrating Productive Mathematics Discussions	
Practice	Description/ Questions
1. Anticipating	What strategies are students likely to use to approach or solve a challenging high-level mathematical task? How do you respond to the work that students are likely to produce? Which strategies from student work will be most useful in addressing the mathematical goals?
2. Monitoring	Paying attention to what and how students are thinking during the lesson. Students working in pairs or groups Listening to and making note of what students are discussing and the strategies they are using Asking students questions that will help them stay on track or help them think more deeply about the task. (Promote productive struggle)
3. Selecting	This is the process of deciding the ***what*** and the ***who*** to focus on during the discussion.
4. Sequencing	What order will the solutions be shared with the class?
5. Connecting	Asking the questions that will make the mathematics explicit and understandable. Focus must be on mathematical meaning and relationships; making links between mathematical ideas and representations.

Algebra 1 Unit 3

Ideal Math Block

The following outline is the department approved ideal math block for grades 9-12.

1) Do Now (7-10 min)
    a. Serves as review from last class' or of prerequisite material
    b. Provides multiple entry points so that it is accessible by all students and quickly scaffolds up

2) Starter/Launch (5 min)
    a. Designed to introduce the lesson
    b. Uses concrete or pictorial examples
    c. Attempts to bridge the gap between grade level deficits and rigorous, on grade level content
    d. Provides multiple entry points so that it is accessible by all students and quickly scaffolds up

3) Mini-Lesson (15-20 min)
    a. Design varies based on content
    b. May include an investigative approach, direct instruction approach, whole class discussion led approach, etc.
    c. Includes CFU's
    d. Anticipates misconceptions and addresses common mistakes

4) Class Activity (25-30 min)
    a. Design varies based on content
    b. May include partner work, group work/project, experiments, investigations, game based activities, etc.

5) Independent Practice (7-10 min)
    a. Provides students an opportunity to work/think independently

6) Closure (5-10 min)
    a. Connects lesson/activities to big ideas
    b. Allows students to reflect and summarize what they have learned
    c. May occur after the activity or independent practice depending on the content and objective

7) DOL (5 min)
    a. Exit ticket

Algebra 1 Unit 3

Ideal Math Block with Intervention Stations

Whole Group Instruction	50 min	INSTRUCTION (Grades 9 – 12) Daily Routine: Mathematical Content or Language Routine Anchor Task: Anticipate, Monitor, Select, Sequence, Connect Collaborative Work* Guided Practice Independent Work (Demonstration of Student Thinking)		TOOLS Manipulatives RESOURCES Agile Mind
Rotation Stations (Student Notebooks & Chromebooks Needed)	1-2X 35 min	STATION 1: Focus on current Grade Level Content STUDENT EXPLORATION* Independent or groups of 2-3 Emphasis on MP's 3, 6 (Reasoning and Precision) And MP's 1 & 4 (Problem Solving and Application) TOOLS/RESOURCES Agile Mind Math Journals	STATION 2: Focus on Student Needs TECH STATION Independent TOOLS/ RESOURCES Khan Academy Approved Digital Provider Fluency Practice	TEACHER STATION: Focus on Grade Level Content; heavily scaffolded to connect deficiencies TARGETED INSTRUCTION 4 – 5 Students TOOLS/ RESOURCES Agile Homework Manipulatives
	5 min	INSTRUCTION Exit Ticket (Demonstration of Student Thinking) TOOLS/RESOURCES Notebooks or Exit Ticket Slips		

Algebra 1 Unit 3

ECRS

ECR Protocol

(Extended Constructed Response)

Issuing

- Moving forward ECR'S will be disseminated by the first of each month and collected by the end of each month
- Method of Issuing: email and post on the website

Dissemination

- Teachers can elect to print copies for each student or use the Smartboard to project the ECR. (Note: Student work will be included in Student Portfolios)
- Students should be given up to 30 minutes depending on the complexity of the ECR
- Assure appropriate testing environment
- ECR should be completed independently

Scoring

- Conversion tables are available in the *Assessment & Data in Mathematics Bulletin* for genesis inputting purposes
- ECR's will count as Authentic Assessments
- Naming Protocol "Course Month ECR" (ex: Grade 6 October ECR)

Collection

- ECR's will be collected & kept in student portfolios
- Student work will be reviewed during CPT's

February ECR

https://www.dropbox.com/sh/ihmokn9l1o0rgm5/AAA3KBBT3-Vx8b_6oFsT0dmEa?dl=0

March ECR

https://www.dropbox.com/sh/7tbwox8zkzifw8z/AAAjrdRh1zXOmkMas1iw_bzSa?dl=0

Algebra 1 Unit 3

ECR Conversion Chart

Points	Genesis Conversion	Points	Genesis Conversion	Points	Genesis Conversion
0	55	0	55	0	55
1	59	1	69	1	69
2	69	2	79	2	89
3	79	3	89	3	100
4	89	4	100		
5	100				