Manhattan Center for Science and Math High School

Mathematics Department Curriculum

Content/Discipline **AP Statistics**

http://mcsmportal.net

Marking Period 1

Topic and Essential Question

Unit 1- (1) What is data? (2) How do we understand and communicate data? Can you lie with statistics? How and to what extent? (3) What assumptions can be made from data? (4) How can graphical displays be manipulated to present misleading information? (5) How can data analysis be used to predict future happenings? Does the data always lead to the truth?

Unit/Topics Unit 1: Exploring and Understanding Data

SWBAT/Objectives

Chapter 1: Stats Starts Here

- Students take a quick survey collecting different pieces of data.
- Students will get an introduction to the layout of the textbook and the different components of the resource including TI-Tips, Step-by-Step Problem Solutions, and Computer Printouts (and how to read them).

Chapter 2: Data

- Students will describe a variable in terms of who, what, when, where, why, and how in the context of the problem.
- Students will classify a variable as categorical or quantitative.
- Students will enter lists into the graphing calculator.

Chapter 3: Displaying and Describing Categorical Data

- Students describe categorical variables and choose an appropriate display such as bar charts, pie charts, and segmented bar charts.
- Students will find marginal and conditional percentages using contingency tables for categorical variables.
- Students write clear, complete, and concise conclusions in the context of the problem.

Chapter 4: Displaying and Summarizing Quantitative Data

- Students describe and display quantitative data using histograms, stem-and-leaf plots, and dotplots, and discuss the advantages and disadvantages of each display.
- Students describe distributions using terms such as uniform, unimodal, bimodal, symmetric, skewed, gap, and outlier.
- Students create histograms in the graphing calculator.
- Students use back-to-back stem-and-leaf plots and side by side boxplots to compare distributions

Chapter 5: Understanding and Comparing Distributions

- Students compute and describe the mean, median, and standard deviation of a set of data.
- Students create a five-number summary and use it to draw a boxplot.
- Students create five-number summaries and boxplots in the graphing calculator.

- Students compare distributions of two or more groups by comparing the center, spread and shape of their corresponding boxplots.
- Students use the outlier rule (1.5 *IQR) to identify outliers.

Chapter 6: The Standard Deviation as a Ruler and the Normal Model

- Students understand the effects of shifting and scaling data on center and spread.
- Students calculate and interpret *z*-scores using the Normal curve and the 68-95-99.7 Rule.
- Students find normal percentiles using both a table and their graphing calculator.
- Students recognize situations in which a Normal model is appropriate.
- Students use the graphing calculator to find *z*-scores, the area underneath a Normal curve, and to draw a Normal probability plot.

Vocabulary/Key Terms

Unit 1: context, data, data table, case, population, sample, variable, units, categorical variable, quantitative variable, frequency table, distribution, area principle, bar chart, pie chart, categorical data condition, contingency table, marginal distribution, conditional distribution, independence, segmented bar chart, Simpson's paradox, distribution, histogram, gap, stem-and-leaf, dot plot, shape, center, spread, mode, unimodal, uniform, symmetric, tails, skewed, outliers, median, range, interquartile range, boxplot, outlier, far outlier, comparing distributions, comparing boxplots, time plot, standardizing, shifting, rescaling, normal model, parameter, statistic, z-score

Assessments:

- Classwork
- Lesson Summary
- Homework
- Warm-up (DO NOW) Quiz next day
- Unit Tests
- Binder Check

Common Core Standards:

Common Core Standards for Math Practices:

Common Core Standards Addressed

N-Q.2 Define appropriate quantities for the purpose of descriptive modeling.
N-Q.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.
N-Q.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.
S-ID.1 Represent data with plots on the real number line (dot plots, histograms, and box plots).
S-ID.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.
S-ID.3 Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers).
S-ID.4 Use the mean and standard deviation of a data set to fit it to a normal distribution and to estimate population percentages. Recognize that there are data sets for which such a procedure is not appropriate. Use calculators, spreadsheets,

	and tables to estimate areas under the normal curve.
Differentiated Instruction:	▪ Flexible grouping ▪ Cooperative Learning ▪ Visual Learning – SMART Board, White board ▪ Visual and interactive questions using the Smart board
ELLs:	▪ Students with ELL's will watch videos (the video has English and Spanish both versions) and additional tutorials about the lesson through the class website. ▪ Students are allowed extra time for works and assessments.
SWDs:	▪ Preview the Key Terms to give students access to context. ▪ Assign chapter summary to give less proficient readers access to content.
High-Achievers:	▪ Have gifted students assist students that are not as gifted. ▪ Ask students to take on leadership roles when working in groups.

Resources/Books

- Graphing Calculator for individual use inside and outside of the classroom.
- Math XL for online HW and study plan
- Schoology/YouTube for unit test reviews
- Bock, David E., and Richard D. DeVeaux. *Stats: Modeling the World.* Boston: Pearson/Addison-Wesley, 2007. (And all ancillary materials)
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- Scheaffer, Richard L., Ann Watkins, Mrudulla Gnanadesikan and Jeffrey A. Witmer. *Activity Based Statistics.* New York: Springer-Verlag, 1996.
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Homework: Per Teacher

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Marking Period 2

Topic and Essential Question

Unit 2- (1) How does one assess normality? (2) Why is the normal distribution essential to the study of statistics? (3) How does the normal distribution apply to the real world? (4) What does it mean to regress? (5) What is association? What is correlation? How are they connected? (6) Does association imply causation? (7) How can modeling data help us to understand patterns? (8) Can we use extrapolation to predict the future? (9) What is the best evidence for causation? Is it possible to test for lack of correlation? (10) How do patterns affect your life?

Unit 3- (1) How do we obtain data? Why is it important? (2) What is bias? How can it be identified? How can it be prevented? To what extent is data biased? (3) To what extent can data be purposely biased? (4) To what extent does data collection methodology affect results? (5) Does size matter?

Unit/Topics

Unit 2: Exploring Relationships Between Variables
Unit 3: Gathering Data

SWBAT/Objectives

Chapter 7: Scatterplots, Association, and Correlation

- Students create scatterplots by hand and on the graphing calculator.
- Students learn when a scatterplot is an appropriate display of data.
- Students use conditions for correlation to determine its appropriateness for a given situation.

Chapter 8: Linear Regression

- Students find least squares regression equation from the summary statistics and correlation.
- Students find a regression equation from the graphing calculator and from computer regression analyses.
- Students find residuals and make and interpret residual plots.
- Students interpret slope, y-intercept, and the value of R^2 in context. Students also understand the misuses of this information.
- Students understand the differences between r and R^2

Chapter 9: Regression Wisdom

- Students know the difference between outliers and influential points.
- Students become aware of the possible effects of outliers, high leverage, and influential points
- Students become aware of the dangers in extrapolation
- Students are able to identify lurking variables

Chapter 10: Re-expressing Data: Get It Straight!

- Students use power and log transformations to achieve linearity.
- Students reverse the re-expressed equations to put a residual or predicted value back into the original units.

Chapter 11: Understanding Randomness

- Students use a table of random digits or their calculator's random number generator to perform a simulation.
- Students describe the step-by-step process for a simulation and draw conclusions from it.

Chapter 12: Sample Surveys

- Students identify the characteristics of simple random samples, stratified sampling, cluster sampling, multistage sampling, systematic sampling from a sampling frame, and convenience sampling.
- Students understand the importance of randomization and are able to identify different types of bias: voluntary response, under coverage, nonresponse, and response.

Chapter 13: Experiments and Observational Studies

- Students identify and recognize the characteristics of observational studies (retrospective and prospective), experiments, and sampling.
- Students use the principles of experimental design to create completely randomized experiments.
- Students use the principles of experimental design to create randomized block experiments.
- Students identify the differences between confounding and lurking variables.
- Students understand the uses of placebos and blinding in experiments.

Vocabulary/Key Terms

Unit 2/Unit 3: Scatterplots, correlation, data, least squares regression, outliers, influential points, extrapolation, lurking variables, high leverage, power and low transformations, re-expressed equations, simulation, random samples, cluster sampling, voluntary response, observational study, experiment, retrospective data, prospective data, block experiment, randomized experiment, placebo, blinding, double blinding, confounding variables

Assessments:

- Classwork
- Lesson Summary
- Homework
- Warm-up (DO NOW) Quiz next day
- Unit Tests
- Binder Check

Common Core Standards:

Common Core Standards for Math Practices:

Common Core Standards Addressed

S-ID.8 Compute (using technology) and interpret the correlation coefficient of a linear fit.
S-ID.9 Distinguish between correlation and causation
S-ID.6 Represent data on two quantitative variables on a scatter plot, and describe how the variables are related.
S-ID.6a Fit a function to the data; use functions fitted to data to solve problems in the context of the data. Use given functions

	or choose a function suggested by the context. S-ID.6b Informally assess the fit of a function by plotting and analyzing residuals. S-ID.6c Fit a linear function for a scatter plot that suggests a linear association. S-IC.3 Recognize the purposes of and differences among sample surveys, experiments, and observational studies; explain how randomization relates to each. F-LE.1 Distinguish between situations that can be modeled with linear functions and with exponential functions F-LE.1b Recognize situations in which one quantity changes at a constant rate per unit interval relative to another
Differentiated Instruction:	▪ Flexible grouping ▪ Cooperative Learning ▪ Visual Learning – SMART Board, White board ▪ Visual and interactive questions using the Smart board
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Marking Period 3

Topic and Essential Question

Unit 4- (1) What is the probability of understanding probability? When is probability a sure thing? (2) How can we base decisions on chance? (3) How can probability be used to simulate events and to predict future happenings? (4) What are the benefits of simulating events as opposed to gathering real data? (5) What is randomness? How can modeling predict the future? (6) To what extent does our world exhibit binomial and geometric phenomena? When is probability a sure thing? How can we base decisions on chance?

Unit 5- (1) How does the normal distribution apply to the real world? (2) How can we use the Central Limit Theorem to understand the variability of a statistic? (3) Does the Central Limit Theorem test one's limit?

Unit/Topics

Unit 4: Randomness and Probability
Unit 5: From the Data at Hand to the World at Large

SWBAT/Objectives

Chapter 14: From Randomness to Probability

- Students understand the Law of Large Numbers.
- Students use the basic rules of probability.
- Students identify and recognize the characteristics of independent events and disjoint events.

Chapter 15: Probability Rules!

- Students use the General Addition Rule and General Multiplication Rule in appropriate situations.
- Students recognize the differences between independent events and disjoint events.
- Students create Venn diagrams, tree diagrams, and two-way tables to organize thinking about probability situations.
- Students find conditional probabilities and are able to use reversed conditioning.

Chapter 16: Random Variables

- Students identify a random variable and calculate its expected value (mean) and standard deviation.
- Students create the probability model for a random variable.
- Students understand the effects of shifting and scaling on mean and variances.
- Students understand the relationship between adding or subtracting random variables and the effect on the variance.

Chapter 17: Probability Models

- Students identify situations involving Bernoulli trials and use either the geometric or binomial probability model for the random variable as appropriate.

- Students calculate geometric and binomial probabilities both by hand and using the graphing calculator.
- Students use the Normal model to estimate a binomial probability appropriately.

Chapter 18: Sampling Distribution Models

- Students use the sampling distribution model of a sample proportion (and difference between two independent sample proportions) and of a sample mean (and difference between two independent sample means).
- Students use the Central Limit Theorem to see that, regardless of the shape of the original population, the distribution of the means of all samples can be described by a Normal model, given large samples.
- Students demonstrate a sampling distribution by simulation.

Chapter 19: Confidence Intervals for Proportions

- Students understand the concept of a confidence interval and interpret it correctly.
- Students recognize the effects of sample size and level of confidence on the margin of error of a confidence interval.
- Students construct a one-proportion *z*-interval using both the formula and the graphing calculator.
- Students recognize the assumptions and conditions necessary for a one-proportion *z*-interval.
- Students calculate a sample size to obtain a desired margin of error and confidence interval.

Chapter 20: Testing Hypotheses about Proportions

- Students use the formal process for testing a hypothesis implementing a procedure of: hypothesis, model, mechanics, and conclusion.
- Students perform a one-proportion *z*-test using both the formula and the graphing calculator.
- Students recognize the conditions necessary for a one-proportion *z*-test.
- Students interpret *P*-values properly in the context of a situation.
- Students recognize when to use a one-sided and two-sided alternative hypothesis.
- Students write their interpretations in clear, concise manner.

Chapter 21: More about Tests and Intervals

- Students recognize the relationship between the critical value for a test and the alpha level.
- Students identify when a result is statistically significant.
- Students describe Type I and Type II errors, and their effect on a situation.
- Students use the idea of the power of a test and recognize the relationships between power, and Type I and Type II errors.
- Students complete a hypothesis test for a population proportion.

Chapter 22: Comparing Two Proportions

- Students find a confidence interval for the difference between two proportions.
- Students perform a two-proportion *z*-test.
- Students recognize the conditions necessary for a two-proportion *z*-test and two-proportion *z*-interval.
- Students recognize the value of and use the idea of pooling appropriately.

Vocabulary/Key Terms	Unit 4/Unit 5: Law of Large Numbers, probability, union, intersection, independent, disjoint (mutually exclusive), conditional probability, tree-diagrams, two way tables, random variable, expected value, mean, variance, shifting, scaling, Bernoulli trials, geometric distribution, binomial distribution, normal approximation, central limit theorem, z0score, s-text, hypothesis testing, confidence interval, margin of error, p-values, type I and type II errors, statistically significant

Assessments:	• Classwork • Lesson Summary • Homework • Warm-up (DO NOW) Quiz next day • Unit Tests • Binder Check
Common Core Standards:	Common Core Standards for Math Practices: **Common Core Standards Addressed** S-CP.1 Describe events as subsets of a sample space (the set of outcomes) using characteristics (or categories) of the outcomes, or as unions, intersections, or complements of other events ("or," "and," "not") S-CP.2 Understand that two events A and B are independent if the probability of A and B occurring together is the product of their probabilities, and use this characterization to determine if they are independent. S-CP.3 Understand the conditional probability of A given B as P(A and B)/P(B), and interpret independence of A and B as saying that the conditional probability of A given B is the same as the probability of A, and the conditional probability of B given A is the same as the probability of B. S-CP.5 Recognize and explain the concepts of conditional probability and independence in everyday language and everyday situations. S-CP.6 Find the conditional probability of A given B as the fraction of B's outcomes that also belong to A, and interpret the answer in terms of the model. S-CP.7 Apply the Addition Rule, P(A or B) = P(A) + P(B) – P(A and B), and interpret the answer in terms of the model. S-CP.8 (+) Apply the general Multiplication Rule in a uniform probability model, P(A and B) = P(A)P(B|A) = P(B)P(A|B), and interpret the answer in terms of the model. S-MD.1 (+) Define a random variable for a quantity of interest by assigning a numerical value to each event in a sample space; graph the corresponding probability distribution using the same graphical displays as for data distributions. S-MD.2 (+) Calculate the expected value of a random variable; interpret it as the mean of the probability distribution S-MD.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. S-MD.4 (+) Develop a probability distribution for a random variable defined for a sample space in which probabilities are assigned empirically; find the expected value.
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