01- Exploring One Variable Data

Content Area: **Mathematics**
Course(s): **AP Statistics**
Time Period: **September**
Length: **7-8 blocks**
Status: **Published**

Transfer

Exam Weighting: 15–23%

Previous Coursework: Students may have experience with some 1 variable statistics, such as mean and median, as well as some experience with normal distributions and the empirical rule.

Developing Understanding: Unit 1 introduces students to data and the vocabulary of statistics. Students also learn to talk about data in real-world contexts. Variability in data may seem to suggest certain conclusions about the data distribution, but not all variation is meaningful. Statistics allows us to develop shared understandings of uncertainty and variation. In this unit, students will define and represent categorical and quantitative variables, describe and compare distributions of one-variable data, and interpret statistical calculations to assess claims about individual data points or samples. Students will also begin to apply the normal distribution model as an introduction to how theoretical models for populations can be used to describe some distributions of sample data. Later units will more fully develop probabilistic modeling and inference.

Building Course Skills: Having access to a world of data is meaningless without the ability to organize and analyze that information. To develop these skills, students will need multiple opportunities to interact with data presented in different formats, i.e., as a table, a graph, or even just a list of values. Students should be asked to verbally describe the patterns and characteristics they see in the data (including shape, center, variability, and unusual features for a quantitative variable) and then compare the characteristics of two different sets of data. Students should also create displays that appropriately represent the data (e.g., using a bar graph for categorical data). Teachers can provide explicit feedback on students' verbal responses so they understand the level of detail needed. For example, when students are asked to describe a distribution of quantitative data, they often provide an acronym associated with that type of distribution (e.g., SOCS or CUSS) but then struggle to discuss all the elements the acronym stands for. In particular, students often neglect to discuss unusual features such as gaps or outliers. Teachers can reinforce that these elements must be addressed in their descriptions and that all data has context (e.g., the variable of interest, including any units of measurement).

Preparing for the AP Exam: In preparation for the AP Exam, teachers can encourage students to carefully read each question and completely answer the question asked. When interpreting representations of quantitative data, for example, students should describe shape, center, and variability, as well as unusual features, such as outliers. A response focused only on the center, for example, would be considered incomplete. Students should also provide complete explanations in context for all conclusions made from data. If asked to justify the selection of a particular conclusion over other options, students should include both a reasoning for their

choice and rationales for not choosing the others.

Enduring Understandings

Given that variation may be random or not, conclusions are uncertain.

Graphical representations and statistics allow us to identify and represent key features of data.

The normal distribution can be used to represent some population distributions.

Essential Questions

How certain are we that what seems to be a pattern is not just a coincidence?

How does one data point compare to other data points in a distribution?

What does it mean for data to be "normal"?

Student Learning Objectives

Included in Summer Assignment:

TEXT Section 1.0: Intro

- Identify the individuals and variables in a set of data.
- Classify variables as quantitative or categorical.

TEXT Section 1.1: Analyzing Categorical Data

- Display categorical data with a bar graph.
- Decide whether it would be appropriate to make a pie chart.
- Identify what makes some graphs of categorical data deceptive.
- Calculate and display the marginal distribution of a categorical variable from a two-way table.
- Calculate and display the conditional distribution of a categorical variable for a particular value of the other categorical variable in a two-way table.
- Describe the association between two categorical variables by comparing appropriate conditional distributions.

TEXT Section 1.2: Displaying Quantitative Data with Graphs

- Make and interpret dotplots and stemplots of quantitative data.

- Describe the overall pattern (shape, center, and spread) of a distribution and identify any major departures from the pattern (outliers).
- Identify the shape of a distribution from a graph as roughly symmetric or skewed.
- Make and interpret histograms of quantitative data.
- Compare distributions of quantitative data using dotplots, stemplots, or histograms.

TEXT Section 1.3: Describing Quantitative Data with Numbers

- Calculate measures of center (mean and median).
- Calculate and interpret measures of spread (range, IQR, and standard deviation)
- Choose the most appropriate measure of center and spread in a given setting.
- Identify outliers using the 1.5(IQR) rule.
- Make and interpret boxplots of quantitative data.
- Use appropriate graphs and numerical summaries to compare distributions of quantitative variables.

Starting in September:

TEXT Section 2.1: Describing Location in a Distribution

- Find and interpret the percentile of an individual value within a distribution of data.
- Estimate percentiles and individual values using a cumulative relative frequency graph.
- Find and interpret the standardized score (z-score) of an individual value within a distribution of data.
- Describe the effect of adding, subtracting, multiplying by or dividing by a constant on the shape, center, and variability of a distribution of data.

TEXT Section 2.2: Density Curves and Normal Distributions

- Use a density curve to model distributions of quantitative data.
- Identify the relative locations of the mean and median of a distribution from a density curve.
- Use the empirical rule to estimate (i) the proportion of values in a specified interval, or (ii) the value that corresponds to a given percentile in a Normal Distribution.
- Find the proportion of values in a specified interval in a Normal distribution use Table A or technology.
- Find the value that corresponds to a given percentile in a Normal distribution use Table A or technology.
- Determine whether a distribution of data is approximately Normal from graphical and numerical evidence.

Vocabulary and Planned Learning Experiences

Vocabulary: statistics, individuals, variables, categorical variable, quantitative variable, discrete variable, continuous variable, distribution, frequency, relative frequency, pie chart, bar graph, two way table, marginal relative frequency, joint relative frequency, conditional relative frequency, side by side bar graph, segmented bar graph, mosaic plot, association, dot plot, stemplot, histogram, symmetric, skewed left, skewed right, shape, center, spread, variability, mean, median, statistic, parameter, range, standard deviation, variance, interquartile range, first quartile, third quartile, resistant, 1.5 IQR Rule, five number summary, boxplot, percentile,

standardized (z) score, cumulative relative frequency graph, transform data, density curve, mean of a density curve, standard deviation of a density curve, Normal distribution, Normal curves, empirical rule, standard Normal distribution, Table A, Normal probability plot

Planned Learning Experiences

Gallery Walk: Have students work in groups of four to construct a dotplot, a stem-and-leaf plot, a histogram, or a boxplot for a set of student-generated data (e.g., time in minutes to get to

school). After the gallery walk, discuss what information can be seen more easily in each graph (e.g., boxplots can easily show the IQR).

FRQ Partner Quiz: Have students work in pairs to answer 2017 FRQ 4. Have one student write and the other perform the calculations. (Although the first part of the question does not require any

calculations, the second part requires calculations to justify the solution.) Discussing and crafting a solution with a partner may require more time than if students completed the
FRQ individually.

Notice and Wonder: Display just the graphs from 2018 FRQ 5. Have students think individually for one minute about how the graphs compare. Then ask them, "What do you notice? What do you

wonder? What questions could be answered with these graphs?" Have students share their ideas with a partner then debrief the ideas as a class.

Reversing Interpretations: Give pairs of students four pictures of normal distributions with various parts shaded. Have students create the question that could have resulted in the picture shown (e.g., if a

value of 15 is labeled and the distribution is shaded to the right of 15, students could write "What is the probability that a value is more than 15?").

Resources

TEXT: The Practice of Statistics, 6th Edition

AP Classroom and the APCD 2019 Course Description

Rossman-Chance Applets

Stats Medic

Assessments

Summer Assignment Reading Quiz on Chapter 1 in text (Introductory level)

Test: Exploring Data (AP Level)

Reading Quiz: Describing Location in a Distribution (Introductory Level)

Reading Quiz: Density Curves and Normal Distributions (Introductory Level)

Test: Modeling Distributions of Quantitative Data (AP Level)

Standards

NJSLS Standards in Mathematics Copied and Pasted as well as linked.

NJSLS Standards - Mathematics

MA.S-IC.A.1 Understand statistics as a process for making inferences about population parameters based on a random sample from that population.

MA.S-IC.B.6 Evaluate reports based on data.

MA.S-ID.A.1 Represent data with plots on the real number line (dot plots, histograms, and box plots).

MA.S-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.

MA.S-ID.A.3 Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers).

MA.S-ID.A.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.

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Modifications (ELL, Special Education, At-Risk Students, Gifted & Talented, & 504 Plans)

ELL:

- Use visuals
- Introduce key vocabulary before lesson
- Provide peer tutoring
- Guided notes and/or scaffold outline for written assignments

Supports for Students With IEPs:

- Allow extra time to complete assignments or tests
- Guided notes and/or scaffold outline for written assignments
- Work in a small group
- Follow all IEP modifications

At-Risk Students:

- Guided notes and/or scaffold outline for written assignments
- Introduce key vocabulary before lesson
- Work in a small group
- Lesson taught again using a differentiated approach
- Use visuals / Anchor Charts

Gifted and Talented:

- Create an enhanced set of introductory activities (e.g. advance organizers, concept maps, concept puzzles)
- Organize and offer flexible small group learning activities
- Teach cognitive and methodological skills

- Organize integrated problem-solving simulations
- Propose interest-based extension activities

Supports for Students With 504 Plans:

- Follow all the 504 plan modifications
- Text to speech/audio recorded selections