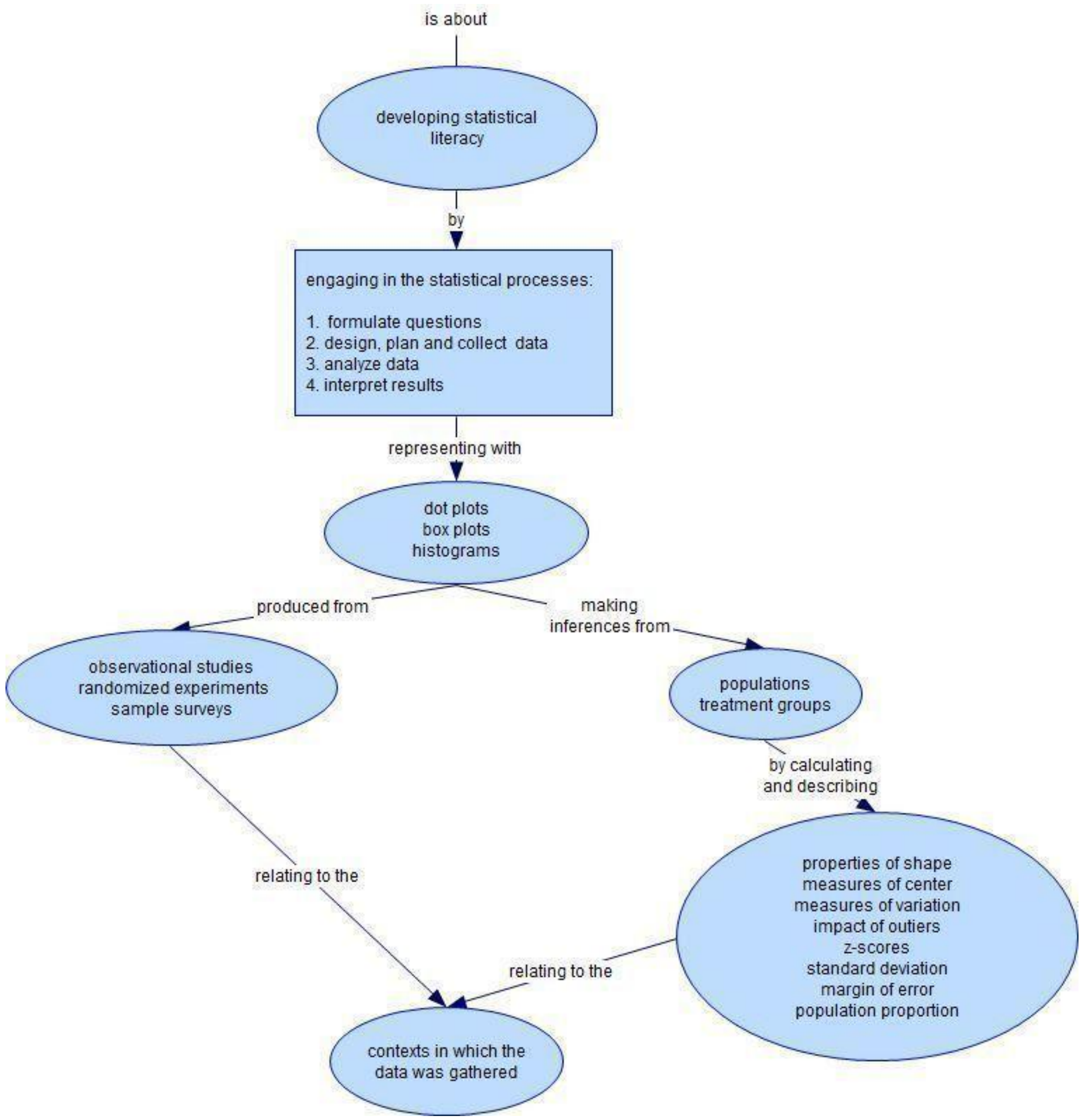
Common Core Initiative

Overarching Questions and Enduring Understandings

How can visual displays and statistical calculations be used to organize, analyze, and evaluate data sets?

Graphic Organizer



Unit Abstract

In this unit, students will build on the knowledge and experience developed in the 6th grade and 7th grade univariate statistics units. (Bivariate data was the statistical focus in 8th grade and Algebra 1.) "They will develop a more formal and precise understanding of statistical inference, which requires a deeper understanding of probability. Students learn that formal inference procedures are designed for studies in which the sampling or assignment of treatments was random, and these procedures may not be informative when analyzing non-randomized studies, often called observational studies." (Progressions for the CCSS-M High School Statistics and Probability, p. 2)"Students now move beyond analyzing data to making sound statistical decisions based on probability models." (Progressions for the CCSS-M High School Statistics and Probability, p.8). In addition, students will deepen their understanding of summarizing, representing and interpreting data on a single measurement variable by applying more complex measurement tools.

As in past data units, students: (1) formulate questions, (2) design a plan to collect data, (3) analyze data, and (4) interpret results/draw conclusions. This unit will build upon students' understanding of statistical variability (quartiles, range, mean absolute deviation*(MAD), outliers) and their capacity to summarize and describe distributions (measure of center, shape) that were developed in middle school. They will now learn to give more precise answers to questions like deciding on which is the more appropriate measure of center, mean or median, and show their deeper understanding by justifying this choice using statistical reasoning. Two major shifts in focus and complexity from middle school to Algebra 2 are the ability to distinguish among distributions that were skewed or approximately symmetric to whether or not they are approximately normal as well as building on their understanding of MAD and applying it to the concept of standard deviation as a measure of variation.

Students will study data sets with generally normal distributions. In a normal distribution, the relationship between the mean, median and the percentages within one, two and three standard deviations from the mean are key to calculating and interpreting data. For a normal data set, students should be able to sketch a graph of the data distribution given information about the measure of center and the distribution and the reverse, describe the measures of center and distribution given a graph.

With respect to random sampling, students move beyond analyzing data, as they did in middle school, to making sound statistical decisions based on probability models. For example, students will apply their understanding of the mean and standard deviation of a data set to fit it to a normal distribution in order to estimate population percentages (S.ID.4). They will use their understanding of calculating margin of error in estimating a population quantity and extend it to the random assignment of treatments to available units in an experiment. Students will recognize the purposes of and differences among sample surveys, randomized experiments and observational studies as they make inferences and justify conclusions from real world contexts.

*NOTE: The mean absolute deviation (MAD), also called the average deviation of a data set $\{x_1, x_2, ..., x_n\}$, is the average of the absolute deviations and is an abstract statistic of statistical distribution or set of data.

Unit Overview (Word)

Unit Overview (PDF)

Content Expectations/Standards

High School: Number/Quantity

Quantities

HSN-Q.A. Reason quantitatively and use units to solve problems.

- HSN-Q.A.2. Define appropriate quantities for the purpose of descriptive modeling.
- HSN-Q.A.3. Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.

High School: Statistics/Probability

Interpreting Categorical & Quantitative Data

HSS-ID.A. Summarize, represent, and interpret data on a single count or measurement variable

Unit Level Standards

There are standards listed in this section for two reasons.

1. ***The standards have been modified to be appropriate for this unit. Text in gray font is part of the Michigan K-12 standard but does not apply to this unit. Text in brackets denotes a modification that has been made to the standard.***
2. ***The standards contain content that is developed and/or utilized across multiple units.***

Modified For this Unit

n/a

Developed and/or Utilized Across Multiple Units

Quantities

HSN-Q.A. Reason quantitatively and use units to solve problems.

- HSN-Q.A.2. Define appropriate quantities for the purpose of descriptive modeling.
- HSN-Q.A.3. Choose a level of accuracy appropriate

- HSS-ID.A.1. Represent 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.
- HSS-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).
- HSS-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.

Making Inferences & Justifying Conclusions

HSS-IC.A. Understand and evaluate random processes underlying statistical experiments

- HSS-IC.A.1. Understand that statistics is a process for making inferences about population parameters based on a random sample from that population.
- HSS-IC.A.2. Decide if a specified model is consistent with results from a given data-generating process, e.g. using simulation.

For example, a model says a spinning coin falls heads up with probability 0.5. Would a result of 5 tails in a row cause you to question the model?

HSS-IC.B. Make inferences and justify conclusions from sample surveys, experiments and observational studies

- 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; justify significant differences between parameters through the use of simulation models for random assignment.
- HSS-IC.B.6. Evaluate reports based on data.

to limitations on measurement when reporting quantities.

Essential/Focus Questions

1. How is data collected (types of samples)?
2. What are some possible sources of bias that occur in collecting data? What are some methods of reducing bias?
3. What is the difference between observational studies, randomized experiments, and sample surveys? What conclusions can be drawn from each?
4. Given a frequency distribution graph, what is the relationship between the median and the mean in a distribution that is skewed to the left? Skewed to the right? Explain why this relationship exists.
5. How can you use mean and standard deviation of a normal distribution to compare two pieces of data?

Key Concepts

bias
census
experimental study
interpret dot plots, relative frequency histograms, bar graphs, and box plots
margin of error
measures of center (mean, median, mode)
measures of variation (percentiles, quartiles, range, IQR, variance, standard deviation)
normal distribution
observational study
outlier
sample
sampling methods
simulation
skewed distribution
symmetric distribution

Assessment Tasks

Assessment Overview

Intellectual Processes

Standards for Mathematical Practice

Students have opportunities to:

- **construct viable arguments and critique the reasoning of others** by using and communicating information about data distributions coherently and clearly to support arguments;
- **Reason abstractly and quantitatively** to build new statistical knowledge through problem solving; and
- **Model with mathematics** to identify and apply statistical techniques to data and data distributions to solve problems with contexts that are outside of mathematics.

Lesson Sequence

Lesson Overview

Resources

Unit Resources