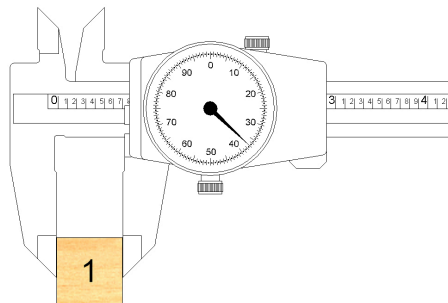


Task: Statistics Quality

I.E.D 9-10

In this lesson you will collect data and then perform a statistical analysis to estimate measures of central tendency and variation of a product (wooden cubes). You will represent the data using a histogram, establish criteria for an acceptable size of the product, and use the Empirical Rule to eliminate product samples that are outside an acceptable range.

1. Obtain a set of 27 wooden cubes ($\frac{3}{4}$ in.) from your instructor. Label each cube (1 through 27) lightly in pencil. Measure the side length of each block along the grain. When taking a measurement, position the block so the caliper measuring surfaces are touching the end grain faces. Record the measurements to create a data set. For this analysis a precision of .001 is necessary; therefore, record each measurement to the nearest one thousandth of an inch (.001 in).



Wood cube 1:	_____	Wood cube 15:	_____
Wood cube 2:	_____	Wood cube 16:	_____
Wood cube 3:	_____	Wood cube 17:	_____
Wood cube 4:	_____	Wood cube 18:	_____
Wood cube 5:	_____	Wood cube 19:	_____
Wood cube 6:	_____	Wood cube 20:	_____
Wood cube 7:	_____	Wood cube 21:	_____
Wood cube 8:	_____	Wood cube 22:	_____
Wood cube 9:	_____	Wood cube 23:	_____
Wood cube 10:	_____	Wood cube 24:	_____
Wood cube 11:	_____	Wood cube 25:	_____
Wood cube 12:	_____	Wood cube 26:	_____
Wood cube 13:	_____	Wood cube 27:	_____
Wood cube 14:	_____		

1. Use Excel to perform a statistical analysis of the data to determine each of the following.

Mean: _____

Median: _____

Mode: _____

Range: _____

Sample Standard Deviation: _____

2. Create a histogram to represent the data. Use seven to ten class intervals (bin values). Be sure to label your axes and define units where appropriate.

3. Print a copy of the Excel worksheet that shows your data, the summary statistics, and your histogram.

Does your data appear to be normally distributed? Justify your answer.

4. Based on past experience, 95% of the wooden blocks received from the manufacturer are within acceptable dimensional limits. However, five percent of the blocks are either too big or too small. When these “out of tolerance” pieces are used to construct a puzzle prototype, the puzzle pieces do not fit well together, and in some cases, the puzzle cannot be solved because of the incorrectly sized wooden cubes.

To minimize the probability that an ill-sized wooden cube will result in a poor prototype, you will determine a range of acceptable side lengths and dispose of any wooden cubes that do not meet your size criteria.

- a. Assuming a normal distribution, determine a criterion of side length values such that approximately 95% of the wooden cubes supplied by the manufacturer will meet your criteria. Show your work.
 - Express your answer using plus/minus notation.
 - Express your answer using a compound inequality.
- b. Without looking at your data, predict the number of your wooden cubes (out of 27) that you would predict will meet the criteria. Justify your answer.
- c. How many of your 27 wooden cubes actually meet the side length criteria?
- d. In most cases, the answers to *b* and *c* above will differ. Why?

Common Core State Standards

List the Common Core State Standards (and math practices if applicable) associated with your task.

CTE Standards and Competencies for Introduction to Engineering Design (PLTW) (Course # 6054) 2013-14

Standard 3 - Students will demonstrate knowledge of Measurement and Statistics.

Standard 7 - Students will demonstrate knowledge of Documentation.

Common Core State Standards for Mathematical Practice (HS)

Unit 3 - Measurement and Statistics

Number and Quantity

Quantities

-Reason Quantitatively And Use Units To Solve Problems.

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 .1)
3. Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. (N.Q .3)

Algebra

Creating Equations

-Create Equations That Describe Numbers Or Relationships

3. Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or non- viable options in a modeling context.

Geometry

Geometric Measurement And Dimension

-Explain Volume Formulas And Use Them To Solve Problems

3. Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems.* (G.GMD.3)

Modeling With Geometry

-Apply Geometric Concepts In Modeling Situations

1. Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder).* (G.MG.1)

Statistics and Probability

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Jun 10, 2014 PLTW Standards and Objectives Alignment

Interpreting Categorical And Quantitative Data

-Summarize, Represent, And Interpret Data On A Single Count Or Measurement Variable

1. Represent data with plots on the real number line (dot plots, histograms, and box plots). (S.ID.1)
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. (S.ID.4)

<http://www.corestandards.org/>

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Next Generation Science Standards

Unit 3 - Measurement and Statistics

Middle School

Engineering Design

MS-ETS1-3. Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success. (MS.ETS1.3)

MS-ETS1-4. Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.

Essential Understandings

Today's consumers are constantly trying to judge the quality of products. But what is quality? How and by whom is quality determined? Some would say the designer creates specifications, which in turn dictate the quality of a product. That quality is also based on the acceptable value of a part within a whole product. Statistics are commonly used in manufacturing processes to control and maintain quality. This activity will allow you to apply statistics in order to analyze and determine the quality. Students should understand that statistical data and analysis can be used to inform, justify, and validate a design or process. What is dimensional analysis and how can it help solve problems involving quantities. How and why engineers generally adhere to a set of dimensioning standards and guidelines.

Possible Solutions/Solution Paths

For this analysis a precision of .001 is necessary; therefore, record each measurement to the nearest one thousandth of an inch (.001 in) using dial calipers.

Create tables in excel to calculate mean, median, mode, range, and standard deviation.

Create histogram to represent data collected.

Using data collected determine how many cubes are outside of the acceptable tolerance range.

Additional Teacher Information

Material required for this task:

Wooden Cube

Engineering notebook

Dial Caliper

Excel