Performance Based Learning and Assessment Task

The Normal Distribution Activity

I. **ASSESSSMENT TASK OVERVIEW & PURPOSE:**
The students are instructed to collect data and use the data to find the mean and standard deviation to construct a bell curve to display the data. The students will also answer questions involving standard deviation, z-scores, and variance.

II. **UNIT AUTHOR:**
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III. **COURSE:**
Algebra I

IV. **CONTENT STRAND:**
Statistics

V. **OBJECTIVES:**
The student will be able to:
- Organize and collect data about the research topic
- Sketch the graphs of the data using the bell curve.
- Use the graphing calculator to assist finding the mean and the standard deviation.
- Analyze the data to successfully express results and conclusions.

VI. **REFERENCE/RESOURCE MATERIALS:**
Calculator & Graph Paper

VII. **PRIMARY ASSESSMENT STRATEGIES:**
Students will be graded on the accuracy of their data results paired with the bell curve. Students will also be assessed on the quality and neatness of their work. There will also be a self-assessment that will provide the student with a checklist and a rubric for the teacher.

VIII. **EVALUATION CRITERIA:**
The self-assessment and teacher assessment will count 21 points each for a total of 42% of the overall score. The following rubric gives a detailed outline of the scoring points. The remaining 58% will be in the form of a benchmark assignment. The benchmark shows how many points each question is worth.

IX. **INSTRUCTIONAL TIME:**
This activity is estimated to take 1 week from the date assigned, but only use 2 class blocks. (1 block to plan and organize the project. Students will be given 4 -5 days to collect the data outside of the instructional time. Then, 1 block to analyze and complete the project.)

Connecting Scatter Plots and Correlation Coefficient Activity

Strand
Algebra I: Statistics

Mathematical Objective(s)
The goal of this activity is be able to take data and correctly use the data to find the mean and the standard deviation to construct a bell curve as well as answer questions involving standard deviation, z-scores, and/or variance. This will also allow students to use higher level thinking skills to create their own example of possible data that could fit the normal distribution.

Related SOL

A.9   The student, given a set of data, will interpret variation in real-world contexts and calculate and interpret mean absolute deviation, standard deviation, and z-scores.

NCTM Standards

- compute basic statistics and understand the distinction between a statistic and a parameter
- use simulations to explore the variability of sample statistics from a known population and to construct sampling distributions

Materials/Resources
- See attached data collection spreadsheet
- See attached results benchmark
- See TI Graphing Calculator Instructions
- Graph Paper
- Graphing Calculator

Assumption of Prior Knowledge
- Students have basic knowledge of central tendency.
- Students should be able to gather data and correctly plot histograms.
- Students will also need to have a basic knowledge of the Z-score formula and recognize the corresponding variables.
- Students may have difficulty entering the data into the graphing calculator and finding the appropriate statistics. The teacher may need to have a written guide for students to follow with the keystroke entry process or the teacher may want to model the process prior to the assignment. The teacher will need to guide the groups by giving helpful hints and/or suggestions.
- The relevant contexts the student will encounter with this activity are: the trends of how data can be spread across the normal distribution in the real world.

Introduction: Setting Up the Mathematical Task

In this activity, you will investigate the relationship between real world data and the normal distribution. Each group will collect data from at least 15 different sources in order to create at least 3 different graphs. Students will be divided into groups of 2 or 3 persons in each group. Below, you will find a detailed outline of what is specifically required.

The Normal Distribution Activity:

1) You have 1 class day to discuss and plan your data collection. Choose 3 of the following options to collect data (1 option must include the create your own option):
   a) Students grades (6 weeks grades, Test grades, Quiz grades, etc…) - optional
   b) People's Heights (choose one gender – male or female) - optional
   c) People's Shoe Sizes (choose one gender – male or female) - optional
   d) Create your own – MUST CHOOSE!
2) Gather the data – You have 4 days outside of class to collect this data or research the data. See attached Data Collection Worksheet.
3) Complete results benchmark and self-assessment. See attached Benchmark. You have 1 class day to complete this task before turning in your final draft of your project.

Student Exploration

Students will be working together in groups of 2-3 students in each group through-out this project. Groups will be chosen by the teacher based on student strengths and weaknesses. The teacher will be circulating and offering guidance when necessary. The teacher should listen to make sure the student's data numbers are making sense. This will also give the teacher a chance to have in depth discussions to address possible questions that may arise such as outliers. After the projects have been turned in for grading, the class will have a discussion about their findings and the conclusions that were drawn. The class will discuss the positive and negatives aspects from this assignment.

Student/Teacher Actions:

- On day 1, students should be discussing which Real World examples will choose. Teachers will listen carefully and make appropriate and encouraging suggestions and comments.
- On days 2-5, students should be gathering their data. Teachers should give daily timeline reminders to the students and answer questions.
- On day 6, students should be using the data to calculate the mean and standard deviation to construct a bell curve and completing the attached benchmark. Teachers will troubleshoot any problems that occur and make suggestions to help guide students in the right direction.
- On day 7, all work should be turned in and class discussion should be held regarding the results of the project.

Monitoring Student Responses

- o Students are to communicate their thinking by asking questions to group members, making suggestions, and being active listeners to others in the group.

o   Students are to communicate with each other in a supportive manner;

o   Teachers are to carefully clarify questions and provide possible problem-solving strategies to overcome difficulties without giving the direct solutions to the students.

Assessment List and Benchmarks

- Students will complete each of the following:

    1. Data Collection Worksheet

    2. Benchmark

    3. Self-Assessment

The Normal Distribution Self/Teacher Assessment

Name: _____

Date: _____ Block _____

NUM	Element	Point Value	Self	Teacher
1	Has the data been correctly entered into the table?	3		
2	Is the data organized and clear to understand?	3		
3	Are there 3 bell curves drawn?	3		
4	Are the bell curves labeled, titled, and plotted correctly?	3		
5	Are the bell curves neat and organized?	3		
6	Are the benchmark questions calculated accurately?	3		
7	Were all elements of the benchmark complete?	3		
	TOTAL	21		

	3 Points	2 Points	1 Point	0 Points
Has the data been correctly entered into the table?	All data was entered correctly into the table.	Almost all data was entered correctly into the table.	Few data was entered correctly into the table	No data was entered correctly into the table.
Is the data organized and clear to understand?	All data is organized and clear to understand.	Most of the data is organized and clear to understand.	Few of the data is organized and clear to understand	The data is not organized nor clear to understand.
Are there 3 Bell Curves drawn?	All 3 bell curves are drawn	At least 2 of the bell curves are drawn.	At least 1 of the bell curves are drawn.	None of the bell curves are drawn.
Are the Bell Curves labeled, titled, and plotted correctly?	All the bell curves are labeled, titled, and plotted correctly.	Most of the bell curves are labeled, titled, and plotted correctly.	Few of the bell curves are labeled, titled, and plotted correctly.	None of the bell curves are labeled, titled, and plotted correctly.
Are the Bell Curves neat and organized?	All of the bell curves are neat and organized.	Most of the bell curves are neat and organized.	Few of the bell curves are neat and organized.	None of the bell curves are near nor organized.
Are the benchmark questions calculated accurately?	All of the benchmark questions are calculated accurately.	Most of the benchmark questions are calculated accurately.	Few of the benchmark questions are calculated accurately.	None of the benchmark questions are calculated accurately.
Were all elements of the benchmark complete?	All the elements of the benchmark were complete.	Most of the elements of the benchmark were complete.	Few of the elements of the benchmark were complete.	None of the elements of the benchmark were complete.
TOTAL				

Data Collection Worksheet

Name: _____

	TITLE
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	

Data Collection Worksheet

Name: _____Example_____

|	High School Female Shoe Sizes
1	10
2	7.5
3	8
4	7
5	8
6	6.5
7	9
8	7.5
9	8
10	8.5
11	7
12	8
13	9
14	6
15	7.5

The Normal Distribution

Name:

_____

Algebra I

Date:_____**Block**_____

1) Plot the first Bell Curve below: (6 points)
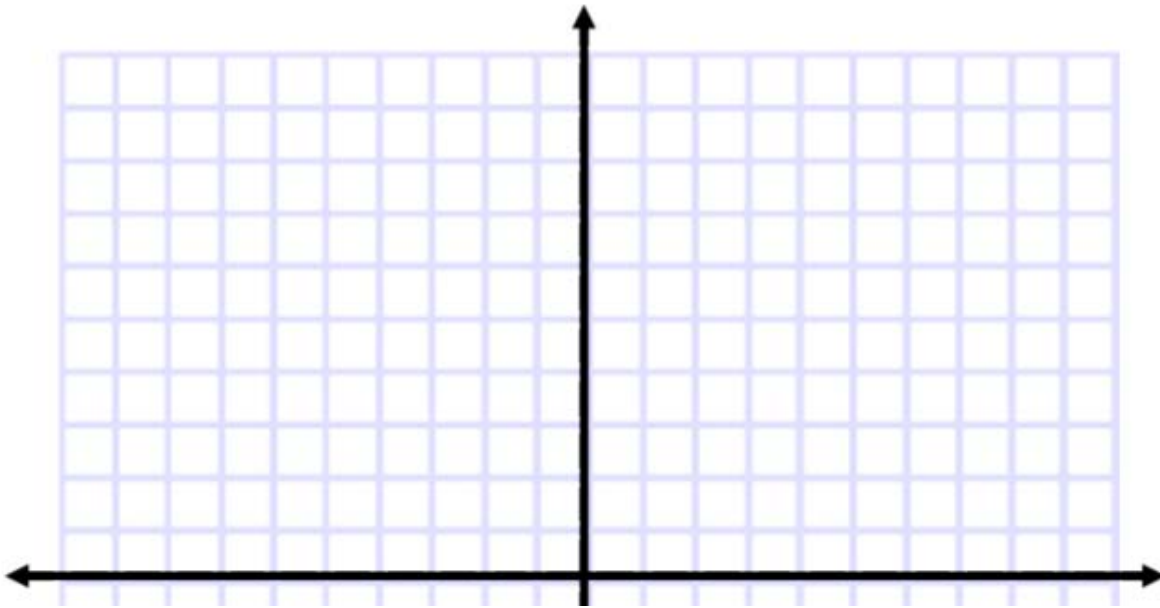
2) What is the data value associated with a z-score of 2.1? _____(2

   points)

3) What is the data value associated with a z-score of -1.7? _____ (2

   points)

4) What is the range of data values that would allow 68% of the data to fall within the mean?

   _____ (2 points)

5) What is the variance of this data set? _____ (2

   points)

6) Are there any outliers with this data set?(Outliers refer to data points that lie beyond 3 standard

   deviation from the mean) _____ (2

   points)

7) Plot the second bell curve below: (6 points)
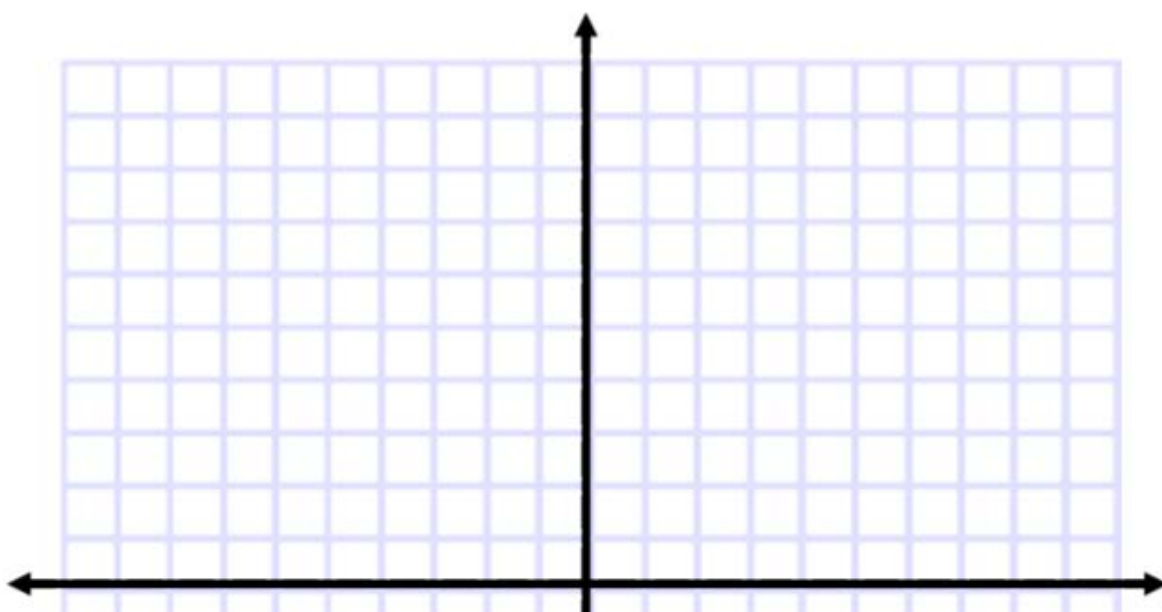
8) What is the data value associated with a z-score of 2? _____ (2 points)

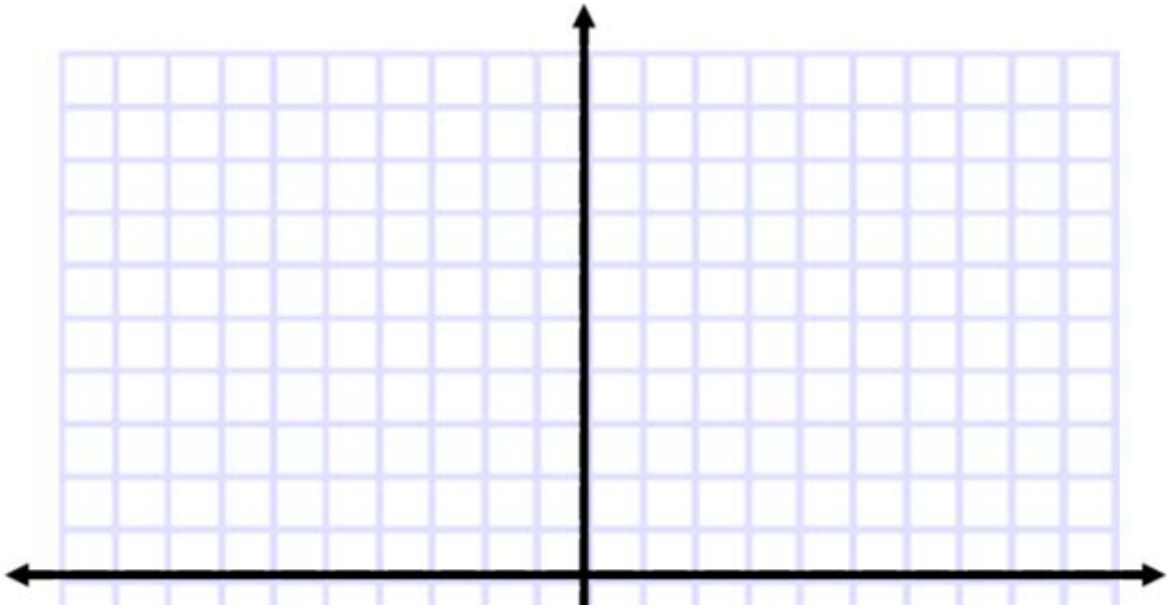9) What is the data value associated with a z-score of -0.8 _____ (2 points)

10) What is the variance of this data set? _____ (2 points)

11) What is the range of data values so that 95% of the data would be within the mean?

_____ (2 points)

12) Are there any outliers with this data set? (Outliers refer to data points that lie beyond 3 standard deviation from the mean) _____

(2 points)

13) Plot the third bell curve below: (6 points)

14) What is the data value associated with a z-score of 0.5? _____ (2 points)

15) What is the data value associated with a z-score of -2.4? _____ (2 points)

16) What is the variance of this data set? _____ (2

points)

17) What is the range of data values so that 99% of the data would fall within the mean?

_____ (2 points)

18) Are there any outliers with this data set? (Outliers refer to data points that lie beyond 3

standard deviation from the mean) _____

(2 points)

19) Why does not 100% of the data always fall within 3 standard deviations of the mean?

_____ (2 points)

20) In your own words define the following vocabulary words:

a) Mean   _____ (2

points)

b) Standard Deviation _____ (2 points)

c) Variance   _____ (2

points)

d) Z-Score   _____ (2

points)

TI Graphing Calculator Instructions

1) Enter the Data
    a) Press STAT & EDIT
    b) Enter the data into L_1 and L_2
2) Press STAT

3) Arrow over to CALC

4) Choose option #1 (1-VAR Stats)

      a) $\bar{x}$ is the mean

      b) σ is the standard deviation for the population(when you survey ALL involved)

      c) s is the standard deviation for the sample(when you survey partial involved)

      d) The variance is calculated by squaring the standard deviation.

Name: __Example__

Date:_____ Block_____

1) Plot the first Bell Curve below:

High School Female Shoe Sizes


```
        -3      -2      -1      0      1      2      3
        4.8     5.8     6.8    7.8    8.8    9.8    10.8
```
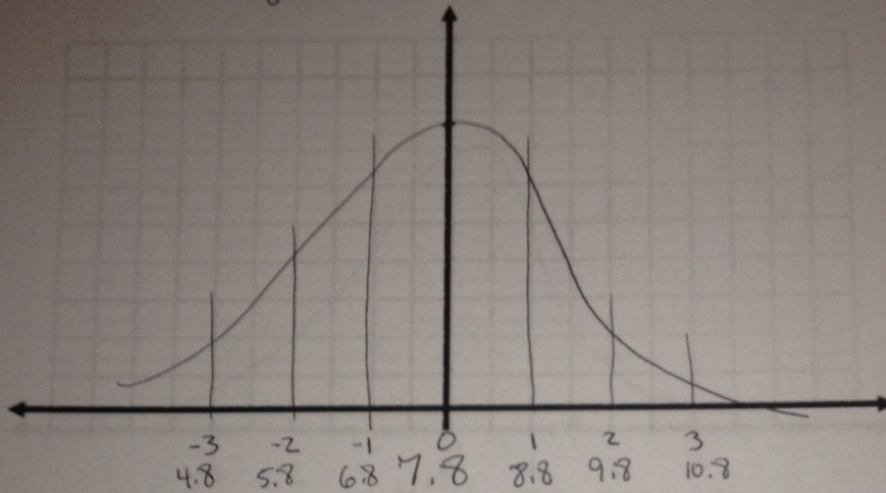
2) What is the data value associated with a z-score of 2.1? __9.9__

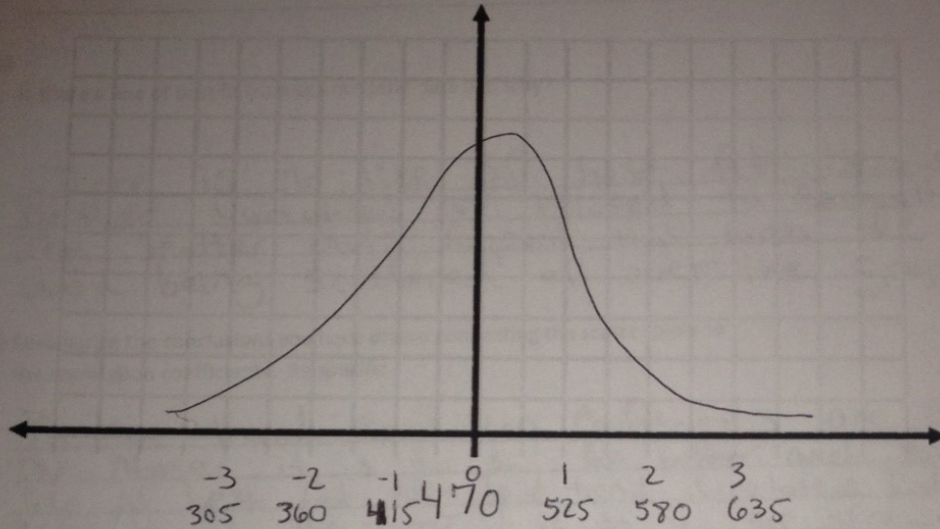3) What is the data value associated with a z-score of -1.7?

__6.1__

4) What is the range of data values that would allow 68% of the data to fall within the mean?

$$6.8 \leq x \leq 8.8$$

5) What is the variance of this data set? __1__

6) Are there any outliers with this data set? __No, all of the data lies within a normal range.__

7) Plot the second bell curve below:

Algebra I SOL Scores

-3	-2	-1	0	1	2	3
305	360	415	470	525	580	635

8)

What is the data value associated with a z-score of 2? __580__

9) What is the data value associated with a z-score of -0.8

__426__

10) What is the variance of this data set?

__3025__

11) What is the range of data values so that 95% of the data would be within the mean?
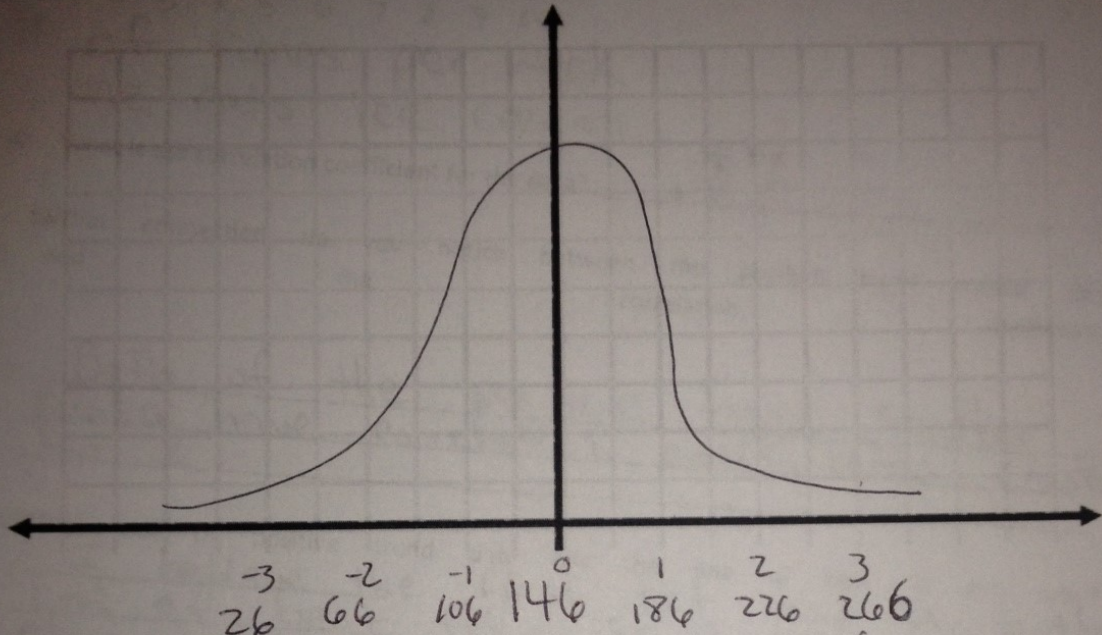
__$360 \leq x \leq 580$__

12) Are there any outliers with this data set?

No, all data seems to lie within the normal range.

13) **Plot the third bell curve below:** High School female weigh

	-3	-2	-1	0	1	2	3
	26	66	106	146	186	226	266

14) What is the data value associated with a z-score of 0.5? __166__

15) What is the data value associated with a z-score of -2.4? __50__

Wha16) is the variance of this data set?

__1600__

17) What is the range of data values so that 99% of the data would fall within the mean?

$26 \leq x \leq 266$

18) Are there any outliers with this data set? __Yes, the data value of 250 seems to lie outside the__

19) Why does not 100% of the data always fall within 3 standard deviations of the mean?

You have to leave room for those extreme cases in case someone we more than 266 lbs or less than 261

20) In your own words define the following vocabulary words:

a) Mean _The average of all the data values ,_

b) Standard Deviation _The amount of variation from the mean._

c) Variance

The square of the standard deviation σ^2

d) Z-Score _How many standard deviations (steps) it is from the mean ._