Performance Based Learning and Assessment Task

Body Measurement Activity

I. ASSESSSMENT TASK OVERVIEW & PURPOSE:
Students will gain experience in data collection and analysis. Through this investigation, students will deepen their understanding of creating graphical representations of data. Students will be determining the line of best fit and establish whether there is a definite correlation between data sets.

II. UNIT AUTHOR:
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III. COURSE:
Algebra Functions and Data Analysis

IV. CONTENT STRAND:
Data Analysis

V. OBJECTIVES:
Student will be able to: 1)Collect data, and generate an equation of best fit, 2)Use the best fit equation to interpolate function values , 3)Make decisions from data results, and justify conclusions with algebraic and/or graphical representations

VI. REFERENCE/RESOURCE MATERIALS:
Students will need: Graphing calculator, Access to Microsoft Office Suite, Tape measure

VII. PRIMARY ASSESSMENT STRATEGIES:
The assessment list and rubric are the primary strategies for assessment. The assessment list possesses two components, both a teacher as well as a self-assessment piece. The mathematical tasks assessed are real world connections and higher order thinking skills (including one or more performance tasks and congruence with AFDA SOL tests)

VIII. EVALUATION CRITERIA:
The teachers are provided the assessment lists, rubrics, and benchmarks to evaluate student work.

IX. INSTRUCTIONAL TIME:
Four to five ninety-minute class sessions

Body Measurement Activity

Strand
Data Analysis

Related SOL
AFDA.3 (The student will collect data and generate an equation for the curve of best fit to model real-world problems or applications. Students will use the best fit equation to interpolate function values, make decisions, and justify conclusions with algebraic and/or graphical models)

NCTM Standards

- Apply and adapt a variety of appropriate strategies to solve problems
- Communicate mathematical thinking coherently and clearly to peers, teachers, and others
- Formulate questions that can be addressed with data and collect, organize, and display relevant data to answer them
- Select and use appropriate statistical methods to analyze data
- Develop and evaluate inferences and predictions that are based on data
- Understand and apply basic concepts of probability

Materials/Resources
Students will need: Graphing Calculator or Microsoft Excel, tape Measure, Microsoft Word (or similar program to type reflection)

Assumption of Prior Knowledge
Before teaching this lesson the teacher should make sure that students are familiar with collecting data, graphing data, determining if there is a correlation between the variables of interest, discovering a line of best fit, determining what type of function the line of best fit represents, and using that line to make predictions. Students should be comfortable using MS Excel and/or TI-83 or TI-84 to plot data, discover and graph lines of best fit, and use this information to make predictions. Students should be comfortable using a measuring tape.

Introduction: Setting Up the Mathematical Task

In this activity, students will investigate the relationship between data sets and developing an algebraic equation of best fit. Based on this equation, students will determine the predictability of certain correlations of physical characteristics.

- This activity will take 4 to 5 school days to complete.
- Students will start by thinking of two body parts in which they want to compare the length and determine whether there is a correlation.
- The students will complete small group work in which they are encouraged to think critically and collaborate with one another.
- The students will make their mathematical thinking public through conversations about problem solving and critically evaluating the analyzing potential solution options.

Student Exploration

Student/Teacher Actions

The teachers play the role of facilitator and monitor:

- Students' data collection of height and arm span and data analysis.
- Students' access to materials.

Students will incorporate technology through basic graph construction with Excel and exploration of graphical representations such as (pie charts, scatter plots, etc.).

Monitoring Student Responses

- Students are to communicate with each other respectfully and appropriately, giving constructive feedback when needed.
- Teachers are to resolve and address misunderstandings during the activity.
- Teachers are to extend the material for students that are ready to move forward and explain overall relevance of activity and real world applications.
- In closure of the activity, the student's will participate in a teacher facilitated discussion about general findings and conclusions of the assignment.

Assessment List and Benchmarks

Attached are student worksheets for the task, assessment rubrics, and benchmarks.

Name: _____

Height of Debate

Every person is unique, which means every class is distinctive because of the composition of students in that class. When looking around us we can compare eye color, hair color, height, age, etc. However, we want to research and discover mathematical correlations using only some of our differences.

Rumors abound about a person's height correlating to the length of their arm span or compared to the length of their feet, the distance from a person's wrist to their elbow compared to their shoe size, etc. We will discover if there is any validity to some of these rumors. For example, is there a correlation between a person's height compared to their arm span, their height with respect to their hair length, their height compared to their foot length, and their height compared to the distance from a person's head to the ceiling, etc.?

Task for whole class participation

1. Gather data about each student's height, length of arm span, hair length, foot length, and distance from the ceiling to each student's head.

2. Create a chart that lists each person's corresponding height, arm span, hair length, foot length, distance from the ceiling to their head, etc.

Individual tasks

1. In a group of 2 or 3, choose 2 attributes and compare them to study about our class.

Examples include, but are not limited to the following:

1. Height compared with arm span
2. Height compared to hair length
3. Height compared to foot length

4. Height compared to distance from their head to the ceiling

(Your group can come up with appropriate attributes to compare, but you must list them on the class measurement sheet and in your reflection.)

2. Using MS Excel or your calculator determine if there is a correlation between your variables of interest. If so, what type of correlation does your data portray?

3. Determine and record the curve of best fit for your data.

4. What type of curve best fits the data (i.e. linear, quadratic, exponential, or logarithmic)?

Individual Objectives

1. Depending on which attributes you selected, use your curve of best fit to determine one of the following for a new member of our class that is 5 foot tall

1) arm span

2) hair length

3) foot length

4) distance from ceiling to a person's head

Etc.

2. Depending on which attributes you selected to compare, answer one of the questions (1 – 4) mentioned above by using your curve of best fit to determine the answer for a new member of our class that is 6 foot 7 inches tall

3. How can you use your curve of best fit to make predictions about any new student that joins our class (i.e. their height with respect to their arm span, their height compared to their hair length, the height compared to their foot length, or the height versus the distance from their head to the ceiling, etc.)? What can you generalize based on your findings?

4. Do you think this generalization would be different for my other classes? Why or why not?

End Result

Each person should complete the following on their own to turn in.

- A typed reflection summarizing your findings (the chart, graph, and equation for curve of best fit), answers to the goal questions, and challenges you had (if any).
- Summary of what you learned during this project.
- Written reflection should be grammatically correct and free of errors.

Student name:	Attribute #1 Height	Attribute #2 Arm span	Attribute #3 Hair length	Attribute #4 Foot length	Attribute #5 Distance from ceiling to person's head	Attribute #6 Other: (Please list below)	Attribute #7 Other: (Please list below)

• **Element (Objective)**		**Earned Assessment**	
	Point Value	**Self**	**Teacher**
1. Completed chart of class data.	2		
2. Selection of one research question to study.	2		
3. Reflection includes chart depicting the data necessary to study the research question.	2		
4. Reflection includes graph with data points and line of best fit.	2		
5. Reflection includes equation of line of best fit and what type of parent function this line belongs to.	4		
6. Reflection includes summary of what you learned through this project.	8		
7. Reflection is free of mechanical and grammatical errors.	2		
8. Work habit throughout this project was exceptional from first stages through completion of assignment (collaboration, problem-solving, perseverance, etc.).	2		

Rubric

Element (Objective)	2 points	1 point	0 points
1. Completed chart of class data.	Completed chart of entire class's data for height, arm span, foot length, & distance from top of head to ceiling, etc. without getting off topic.	Completed chart of entire class's data for height, arm span, foot length, & distance from top of head to ceiling, etc. only getting off topic 1 or 2 times.	Completed chart of entire class's data for height, arm span, foot length, & distance from top of head to ceiling, etc. getting off topic numerous times and disrupted class.
2. Selection of one research question to study.	Group peaceably discussed and decided on one research question.	Group did not discuss research questions, one member chose the topic.	Group argued about what topic would be chosen.
3. Reflection includes chart depicting the data necessary to study the research question.	Reflection includes only the data being researched (i.e. height & arm span, height & foot length, etc).	Reflection includes only part of the data being researched (i.e. height OR arm span, height OR foot length, etc.).	Reflection does not include a chart depicting the data being studied.
4. Reflection includes graph with data points and curve of best fit.	Reflection includes graph with data points AND curve of best fit.	Reflection includes graph with data points, but not the curve of best fit.	Reflection does not include graph with data points OR line of best fit.
5. Reflection includes equation of line of best fit and what type of parent function this line belongs to (points doubled).	Reflection includes equation of curve of best fit AND type of function.	Reflection includes equation of curve of best fit, but not what type of function.	Reflection does not include equation OR what type of function.
6. Reflection includes summary of what you learned through this project (points earned multiplied by 4).	Reflection includes detailed summary of what you learned.	Reflection includes minimal details summarizing what you learned.	Reflection does not include a summary of what you learned through this project.

7. Reflection is free of mechanical and grammatical errors.	Only 1 or 2 errors.	2 – 5 errors.	6 or more errors
8. Work habit throughout this project was exceptional from first stages through completion of assignment (collaboration, problem-solving, perseverance, etc.).	Work habit was exceptional	Work habit could be improved.	Work habit was very poor and needs major changes.

Benchmark work

Data sample:

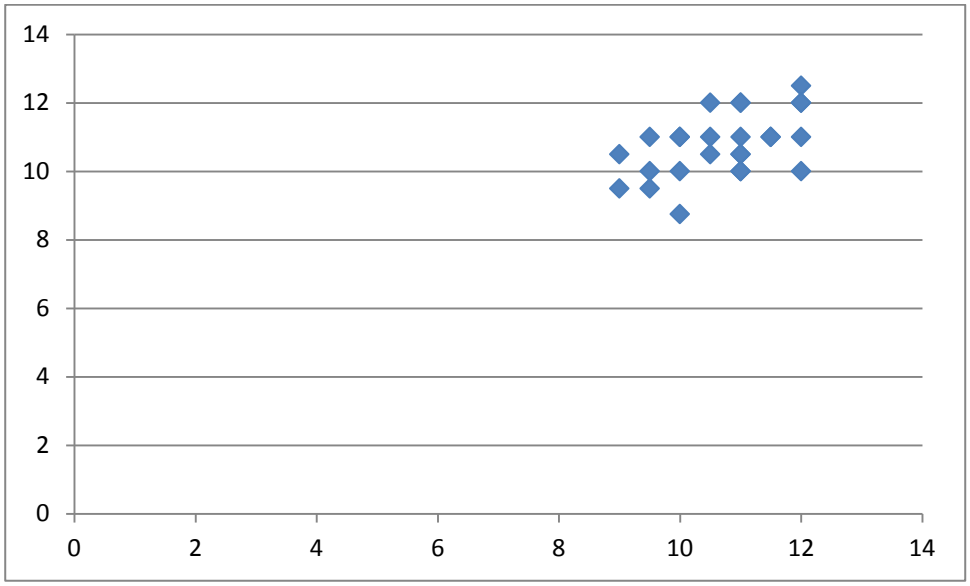
Student #:	Height	Arm Span	Foot Length	Distance from ceiling to person's head	Other: Thumb/ pinkie length	Other: Elbow to wrist
1	60	60	10	37	2.2/2.4	8.75
2	71	71	12	25	2.5/2.5	10
3	70	70	11	27	2.5/2.75	11
4	65.75	65.75	10	31.5	3/2.6	11
5	62	62	9	34	2.2/2.8	9.5
6	68	70.25	10.5	29	3/2.5	11
7	67	67	11	29.5	2.5/2.5	10
8	68.5	67	10	29.25	2.5/3	10
9	71	71	11.5	27	3/2.75	11
10	71.25	74	11	26.5	3 3	12
11	67.5	67.5	10	30	2.5/2.75	11
12	64.5	60	9	33.5	2.5/3	10.5
13	69	69	10.5	28.25	2/2.5	10.5
14	67.5	65	10.5	31	3/2.5	12
15	61	60	9.5	36.5	2/2.5	9.5
16	76	79	12	21.5	3 3	12.5
17	72	72	12	25.8	2.5/3	12
18	68	66.25	11	29.5	2.5/2.5	10.5
19	69	69.5	11	29	3 3	12
20	73	74	12	24	2.5/3	11

21	64	61.75	9.5	33	2.5/3	10
22	66	66.5	11.5	32	3 3	11
23	65.75	64	9.5	32.5	3/2.5	11
24	72	71	12	25.5	3 2.5	12
25	69.5	66.5	11	28	2.5/2.5	10.5
26	70	68.25	11	28	3 3	10

Example 1:

Reflection of the Height of Debate Project

In Algebra II class we completed the Height of Debate Project. We were required to pick two attributes to compare. Zach and I chose to compare foot length and elbow to wrist length. We took the measurements and recorded them in class. Then we graphed the results to see if there was any correlation. The graph of our data is shown below.



The graph shows that there is no relative correlation. We checked with the calculator to see if any of the curves fit the data. All of the r values equaled about 0.5. This data confirmed that there is no curve of best fit and no correlation between foot length and elbow to wrist length. This project made me more familiar with scatterplots and linear regression. I learned that not all parts of the human body correlate with each other, and that it is fairly easy to compare a number of different things to see if there is any correlation between them.

Example 2:

"Height of Debate" Project

Height vs. Armspan

For this project, my group chose to compare the height to armspan of the students in our class. We found that the data had a strong positive correlation where the curve of best fit was cubic because, at .9513645204, the r-value was the closest to 1. Using the curve of best fit, we believe a new member of the class who is 5 foot tall would have an armspan of about 60 inches, and a new member of the class who is 6 foot 7 inches tall would have an armspan of about 79 inches. You can use the curve of best fit to make predictions about a new student joining the class by analyzing the data you already have and seeing that a person's height is almost always around the same length as their armspan. This generalization would most likely be similar for other classes because the majority of the data from this class followed that generalization.

Curve of Best Fit Equation: ax^3+bx^2+cx+d

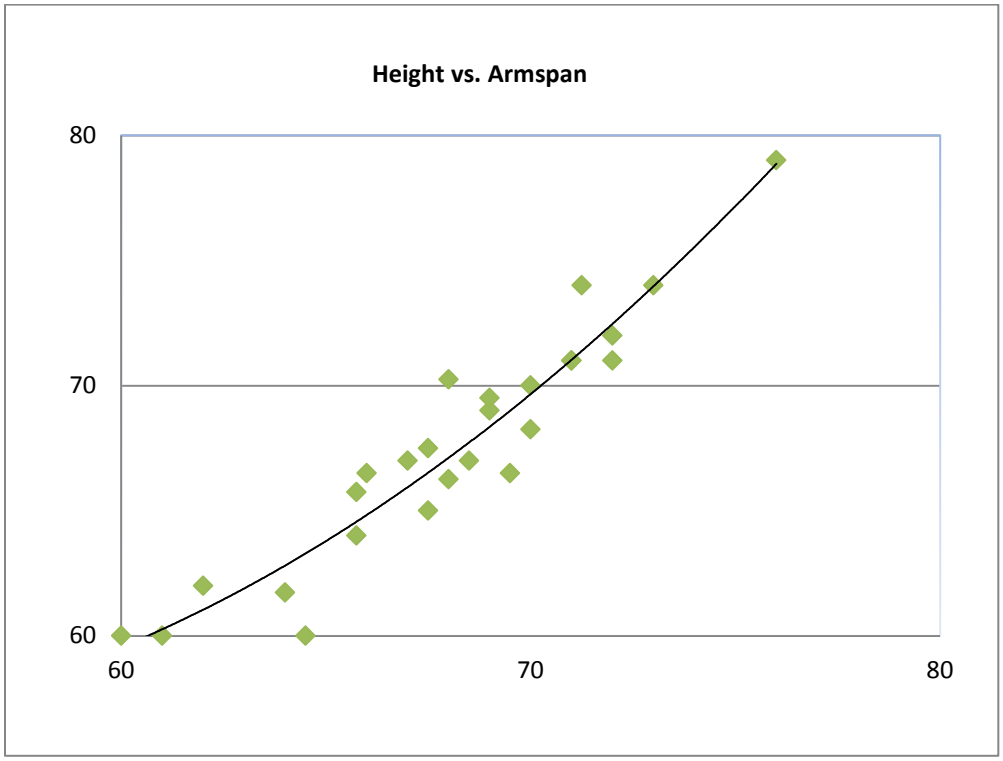
a- -.000791319
b- .193824465
c- -14.14459015
d- 381.5162423

Data Chart:

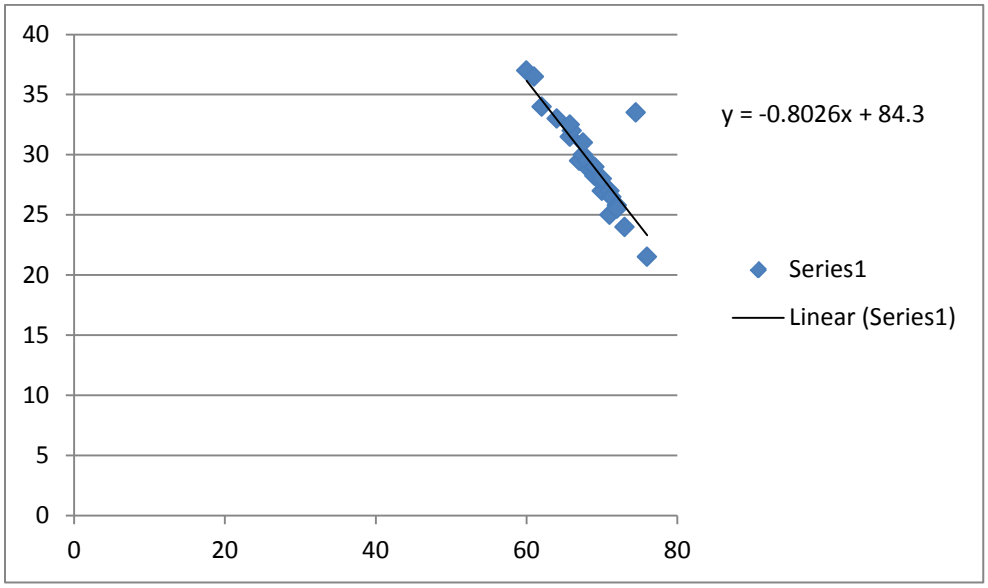
Height	Armspan	Height	Armspan
60	60	67.5	65
71	71	61	60

70	70	76	79
65.75	65.75	72	72
62	62	68	66.25
68	70.25	69	69.5
67	67	73	74
68.5	67	64	61.73
71	71	66	66.5
71.25	74	65.75	64
67.5	67.5	72	71
64.5	60	69.5	66.5
69	69	70	68.25

Graph of Data and Curve:

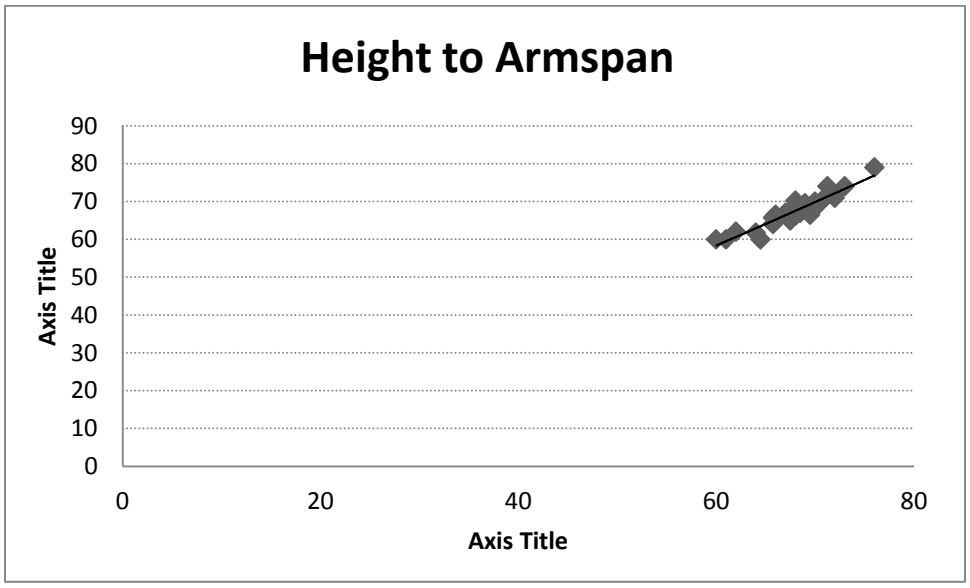


Example 3:



Our group decided that the correlation for the attributes we chose was linear. The equation for our graph was y=-0.9757486673(x) +95.77474344. Throughout this project I learned that the taller the person, the shorter the distance from the ceiling to their head is. I also learned that by using the formula we could make predictions about the distance of other people's head to the ceiling. We determined that the distance for a person who is five feet tall would be about 37.23 inches. We also calculated the distance of a person who is six feet seven inches tall. The distance for that person would be about 18.7 inches. This generalization would not be different for other classes due to the fact that the height of the ceiling remains constant.

Example 4:



We compared the attributes of height to arm span because we wanted to see if they are always the same. After comparing linear, exponential, quadratic and logarithmic we concluded quadratic is the curve of best fit because the R value was closest to one. The equation we found for quadratic is $y = 0.325648008\ x^2 + -3.221357354\ x + 135.5950531$ and it belongs to the quadratic parent function. In this project, I learned how to graph a scatter plot by using the calculator and the data given. I learned to find the curve of best fit by comparing it to the different types, such as linear, quadratic, exponential, or logarithmic, and looking at the R values and deciding which one was closer to one or negative one. The challenges I had facing this project was figuring out the goals. The first question asked to use the curve of best fit to determine the arm span for a new member of the class that is five foot tall. The arm span for a new student would be about 59.546895. The next question was for a different member that is six foot seven inches tall. We found their arm span to be about 84.344745. The curve of best fit can be used to make predictions by using the values to find the y value based on the data. Height and arm span are closely related but not always the same. The generalization should be the same for other classes because the majority of students are either exact to their arm span or extremely close.