Performance Based Learning and Assessment Task

Data Driven

I. ASSESSSMENT TASK OVERVIEW & PURPOSE:

Students will be given four data sets to analyze. Students will need to consider the context of each situation that the data describes and predict which curve would best fit the data. Students will then collect data which is pertinent to a question or problem in their life or school. Students will then analyze the data in pursuit of answering the question or problem. Students will need to provide a possible answer to the problem posed utilizing the data collected. The students will create a display board to present the data, in both a tabular and graphical format. The problem statement and answer should be presented on a display board as well.

II. UNIT AUTHOR:

Kelly Blackwell, Floyd County High School, Floyd County Public Schools

III. COURSE:

Algebra, Functions, and Data Analysis

IV. CONTENT STRAND:

Algebra and Functions

V. OBJECTIVES:

The student will be able to:

- Consider the context of the data situation and predict the curve that would be most applicable fit of the data.
- Explain the reasons for choosing that particular function for each posed data set.
- Identify a problem or question in their life or school that could be solved using data.
- Collect the data to analyze for a solution.
- Display the problem situation and present their solution utilizing the data to support their answer.

VI. REFERENCE/RESOURCE MATERIALS:

Students will need a copy of the handout with the data sets, titled Part I. Students may need their graphing calculator to investigate the data. Students will need some resources for data collection; methods may vary but may include cellular devices, iPads, cameras, stop watches, measuring tapes, etc. Students will need access to a computer or a graphing calculator to help them with data analysis.

VII. PRIMARY ASSESSMENT STRATEGIES:

Students will be assessed on the strength of their statement supporting their curve choice for each data set in the Part I activity. Students will be assessed on their display created which will include the problem statement, data collected and displayed, as well as students' solution to the problem.

VIII. EVALUATION CRITERIA:

A rubric for scoring the strength of student's statements to support their curve choice is included. A rubric for scoring the display board included.

IX. INSTRUCTIONAL TIME:

This activity should take two 90-minute class periods.

Data Driven Task

Strand
Algebra and Functions

Mathematical Objectives
The student will consider the given data sets and find the family of curves that best fit the data. Students will describe how and why they chose that curve to model the data in a paragraph. The students will then find a problem in their life or school that could be investigated and solved using data. Students will collect data in connections with their problem and then explore the data by plotting the data points, finding curve of best fit, and possible using it to predict future data points. Students will then organize and present their findings.

Related SOLs
AFDA. 3 (utilizing data from the real world to make conclusions)

AFDA. 4 (multiple representations of the data)

NCTM Standards
- Understand and compare the properties of classes of functions, including exponential, polynomial, rational, logarithmic, and periodic functions.
- Draw reasonable conclusions about a situation being modeled.

Materials/Resources
Students will need the following to complete the activity:
- Activity sheet with data sets
- Data collection devices
- Scissors, glue or tape
- Graphing calculator and/or computer
- Display board

Assumption of Prior Knowledge
- Students will understand the basic parent graphs and equations of the linear, quadratic, exponential, and logarithmic families.
- Students will know how to analyze a set of data to determine which family of functions it could model.
- Students will know how to collect data regarding a problem situation.
- Students will know how to enter data into the graphing calculator or spreadsheet software.
- Students will know how to calculate the line or curve of best fit in the calculator or spreadsheet software.
- Students will know how to use model to predict or answer questions regarding the data collected.

Introduction: Setting Up the Mathematical Task

Students will be considering data in a real life setting. Students will need to study the context of each situation and choose a family of curves that would best fit the data given. Students will provide a paragraph of explanation of their choice. Students will be brainstorming to find a situation in their school or life that could be fixed or made more productive by looking at data regarding the problem. Students will be analyzing the data using software or the graphing calculator to answer the question or to predict future events.

Student Exploration

Student/Teacher Actions:

- Teachers will need to place students in diversified ability groups of three.
- Students will need to ponder each data set given in the context described in order to determine which function family to which each data set belongs.
- Students will need to be able to explain which function family each data sets belongs using complete sentences and mathematical reasons that persuade the reader of their choice.
- Students will need to brainstorm to find a problem statement to investigate. The problem should require data collection and/or analysis to make something better or to answer a question.
- Teachers may need to advise students in finding a problem to investigate. Examples include improvement in sports, academic problems with students in the classroom, or issues within the school that need to be addressed.
- Students will need to collect data or ask for data regarding the problem situation.
- Teachers may need to focus students on a particular area or question to investigate or help them decide what type of data would be appropriate.
- Students will need to analyze the data in some way to answer their problem statement.
- Students will need to display their findings in a cohesive way following the given rubric.

Monitoring Student Responses

- Teachers could encourage students to enter the data from the given data sets activity into their graphing calculator to do a scatterplot or to plot the data points by hand to aid in recognizing the appropriate function family.
- Teachers need to monitor student's responses on the data sets paragraphs. Responses should be complete thoughts and provide mathematical reasons for their choice.
- Teachers should make students aware of the different ways that are available to collect the data using different devices, including phones with cameras, iPads, stopwatches, tape measurers, etc.
- Teachers may need to help students in using spreadsheet software to display their data and creating curves of best fit if necessary to answer questions related to the data.
- The task may be overwhelming for some students. If students are off task, it could be a signal for more guidance is needed. Teachers could model the five parts of the project by showing the benchmark as an example.

Assessment List and Benchmark

- Students will be assessed on the completion of the data sets worksheet, which will include statements supporting each choice. The strength of the four statements will be assessed using the following rubric. A benchmark of this part of the task is provided below.
- Complete the following rubric for each of the four data sets provided. Each data set has a possible score of 9 points. The total for this part of the task is 36 points.
- Students will be assessed on the completion of a display board to showcase their data collected in response to a problem or situation that they investigated. A benchmark for this portion of the task is provided below.

- Complete the following rubric for the display board for each group. A total for this part of the task is 12 points.
- Teachers could scale each portion of the task to finalize the grade on the complete task.

Rubric for the Data Sets Activity – Part I

Requirement	**0**	**1**	**2**	**3**
Grammar, complete sentences, ease of reading	No statement was written to support answer.	The statement is hard to understand because of grammar mistakes and incomplete sentences.	The statement has several grammatical errors that take away from the strength of the statement.	The statement is well written and has little to no grammatical errors.
Strength of statement in supporting the choice of the family of curves	No statement was written to support answer.	The statement provides no mathematical reasoning for the choice.	The statement has some valid points supporting curve choice, but lacks all of the necessary mathematical reasons.	The statement provides clear mathematical reasons why the data given matches a particular family of functions.
Accuracy of curve choice	Wrong curve choice or no choice provided	n/a	n/a	Correct curve choice

Rubric for the Display Board – Part II Data Driven

Requirement	**0**	**1**	**2**	**3**
Purpose of Data Collection	Data was not collected	Data was collected but did not pertain to the problem statement	Problem statement is clear but data is not entirely appropriate to situation	Problem statement was clear and concise and appropriate data was collected
Items to be present on the Display Board ***-problem statement*** ***-data set*** ***-scatterplot of data*** ***-curve of best fit or appropriate analysis provided*** ***-solution provided***	None of these items were present on the display board	One or two of these items were present on the display board	Three or four of these items were present on the display board	All items were present on the display board
Organization and Clarity of Display Board	Board is impossible to understand	Board is difficult to understand and follow process	Board is somewhat organized but portions could be improved	Display board is well organized and each step flows into the next

Calculations	No data analysis or calculations occurred	Many errors exist in calculations	Minor errors were found, but general outcome was minimally affected	All calculations are accurate

Portion of Rubric Part I & Part II	**Self-Assessment and/or Checklist**	**Teacher Evaluation**
Grammar, complete sentences, ease of reading		
Strength of statement in supporting the choice of the family of curves		
Accuracy of curve choice		
Purpose of Data Collection		
Items to be present on the Display Board ***-problem statement*** ***-data set*** ***-scatterplot of data*** ***-curve of best fit or appropriate analysis provided*** ***-solution provided***		
Organization and Clarity of Display Board		
Calculations		

Part I: Given the following sets of data, determine whether each set is

Linear, **Quadratic,** Exponential, or Logarithmic.

Write a paragraph for each set of data describing why you think it would be modeled best by this function. Consider the context of each data situation and predict what type of graph the data will model.

Age of Tree (in years)	Height (in feet)
1	4
2	6
3	8
4	9.25
5	10
6	10.5
7	10.9
8	11.25
9	11.5
10	11.6

Which function would you choose? Why?

Hours Spent Studying	Math SAT Score
1	350
4	400
5	450
6	470
8	500
10	550
12	585
14	630
16	650
18	675
20	710
22	730
25	750
30	770
32	790

Which function would you choose? Why?

Speed, x	15	20	25	30	35	40
Fuel economy, y	22.3	25.5	27.5	29.0	28.8	30.0
Speed, x	45	50	55	60	65	70
Fuel economy, y	29.9	30.2	30.4	28.8	27.4	25.3

Modeling with Quadratic Functions. (n.d.). Retrieved October 10, 2014, from http://www.classzone.com/eservices/home/pdf/teacher/LA205HAD.pdf

Which function would you choose? Why?

Time (mins)	Temp (F)
0	179.5
3	170.4
5	168.3
8	157.4
11	148.9
15	140.7
19	132.5
22	124.4
25	122.5
30	115.3
33	112.2
38	108.1
42	104.7
45	101.2
51	99.5

Which function would you choose? Why?

Benchmark

Part I: Given the following sets of data, determine whether each set is

Linear, **Quadratic,** Exponential, or Logarithmic.

Write a paragraph for each set of data describing why you think it would be modeled best by this function. Consider the context of each data situation and predict what type of graph the data will model. Use mathematical reasoning including some of the attributes used in the previous activity.

Age of Tree (in years)	Height (in feet)
1	4
2	6
3	8
4	9.25
5	10
6	10.5
7	10.9
8	11.25
9	11.5
10	11.6

Which function would you choose? Why?

The data set would best be modeled by a logarithmic function. The data grows rapidly at the beginning. For instance, 3.5 feet in each of the first two years, but begins to slow. It only grows two feet in the third year and 1 ½ feet the next year. The height is increasing as the age of the tree is increasing, but the height begins to slow as the tree gets older. As the tree gets older, its height will level off creating a horizontal asymptote on the graph.

Hours Spent Studying	Math SAT Score
1	350
4	400
5	450
6	470
8	500
10	550
12	585
14	630
16	650
18	675
20	710
22	730
25	750
30	770
32	790

Which function would you choose? Why?

The data set would best be modeled by a linear function. According to the data, if the number of hours studying is low, the SAT score is low. If the number of hours studying is high, the SAT score will be high. The direct variation relationship is easily recognizable. The SAT score seems to increase approximately 50 points for every two hours of study time.

Speed, x	15	20	25	30	35	40
Fuel economy, y	22.3	25.5	27.5	29.0	28.8	30.0
Speed, x	45	50	55	60	65	70
Fuel economy, y	29.9	30.2	30.4	28.8	27.4	25.3

Modeling with Quadratic Functions. (n.d.). Retrieved October 10, 2014, from http://www.classzone.com/eservices/home/pdf/teacher/LA205HAD.pdf

Which function would you choose? Why?

The data set would be modeled by a quadratic function. As the x values increase, the y values increase then begin to decrease at the end of the data set. The data has an absolute maximum that occurs at x=55 and y=30.4. Using this data we can predict at a speed above or below 55, the fuel economy will continually decrease.

Time (mins)	Temp (F)
0	179.5
3	170.4
5	168.3
8	157.4
11	148.9
15	140.7
19	132.5
22	124.4
25	122.5
30	115.3
33	112.2
38	108.1
42	104.7
45	101.2
51	99.5

Which function would you choose? Why?

The data set would be modeled by an exponential function. The largest temperature is achieved at the initial time of zero minutes. The temperatures decrease for the entire data set, but the rate of decrease is slower at the end of the data set.

Part II – Data Driven

Your group needs to investigate a problem or situation in your life or in our school that could be solved or improved by analyzing data connected to the situation. Your group will be collecting data using methods such as video, cameras, iPads, stopwatches, measuring tapes or data could be requested from a school official. All of the following items should be included on a display board to summarize your findings.

1) Problem statement

2) Data displayed in table

3) Data displayed in a graphical format

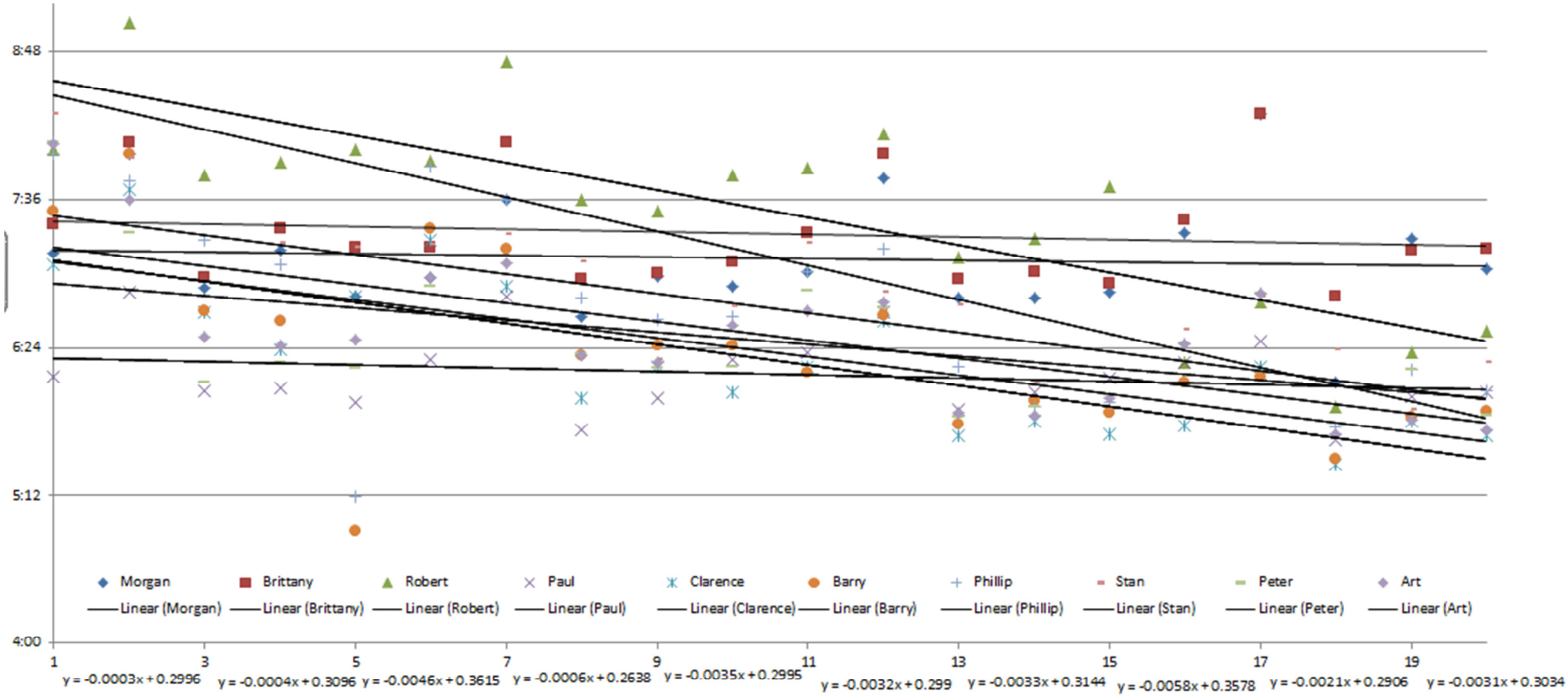
4) Data analysis

5) Answer to the problem statement

Benchmark – Display Board

The FCHS Cross Country team has had an excellent year. As the end of the season approaches, the coach needs some help in determining the most improved runner. The following data set was provided including ten seniors and their mile times at five consistent races over the last four years. Our task is to discover the athlete that has shown the most improvement during their tenure as a runner at FCHS. This senior will receive a scholarship in the amount of $2000 from a local company.

RACE	Morgan	Brittany	Robert	Paul	Clarence	Barry	Phillip	Stan	Peter	Art	
1	7:10	7:24	8:00	6:10	7:04	7:30	7:58	8:18	8:04	8:03	2011
2	7:58	8:04	9:02	6:51	7:41	7:58	7:45	7:56	7:20	7:36	
3	6:53	6:58	7:48	6:03	6:41	6:42	7:16	11:56	6:07	6:29	
4	7:11	7:22	7:54	6:04	6:23	6:37	7:04	7:15	6:17	6:25	
5	6:49	7:13	8:00	5:57	6:49	4:55	5:12	7:13	6:14	6:28	
6	6:58	7:13	7:55	6:18	7:16	7:22	7:52	7:14	6:54	6:58	2012
7	7:36	8:04	8:43	6:49	6:54	7:12	7:36	7:19	6:37	7:05	
8	6:39	6:57	7:36	5:44	5:59	6:20	6:48	7:06	6:21	6:20	
9	6:59	7:00	7:30	5:59	6:15	6:25	6:38	6:18	6:14	6:17	
10	6:54	7:06	7:48	6:18	6:02	6:25	6:39	6:44	6:15	6:35	
11	7:01	7:20	7:51	6:22	6:15	6:12	7:01	7:15	6:52	6:42	2013
12	7:46	7:58	8:08	6:41	6:37	6:40	7:12	6:51	6:43	6:46	
13	6:48	6:57	7:08	5:54	5:41	5:47	6:15	6:45	5:50	5:52	
14	6:48	7:01	7:17	6:02	5:48	5:58	5:55	6:06	5:55	5:51	
15	6:51	6:55	7:42	6:09	5:42	5:52	5:57	6:30	6:01	5:59	
16	7:20	7:26	6:17	6:17	5:46	6:07	6:26	6:33	6:26	6:26	2014
17	8:18	8:18	6:46	6:27	6:15	6:10	6:50	6:49	6:50	6:50	
18	6:07	6:49	5:55	5:39	5:27	5:30	5:45	6:23	6:05	5:42	
19	7:17	7:11	6:22	6:00	5:48	5:50	6:13	5:54	6:13	5:49	
20	7:02	7:12	6:32	6:02	5:41	5:53	6:03	6:17	5:51	5:44	



AND THE WINNER IS…

Based upon the lines of best fit of the data collected, my pick for the runner most improved over the last four years would be Stan. The slope of the regression line that best fits his data was the steepest at -0.0058. The slope of the regression line is negative because Stan's miles times were steadily declining throughout his four years of running cross country at FCHS. Of course, different races are better for some runners than others, so this analysis is based on the overall trends in the data.