I Want to Rock!

I. ASSESSMENT TASK OVERVIEW & PURPOSE:
The task is designed to allow students' to show their understanding of direct and inverse variation in a real-world context.

II. UNIT AUTHOR:
Traci Drew, Nansemond River HS, Suffolk Public Schools
Karrie Hadfield, William Byrd HS, Roanoke County Public Schools

III. COURSE:
Algebra I

IV. CONTENT STRAND:
Algebra and Functions

V. OBJECTIVES:
The learner will be able to:

- determine whether direct or inverse variation exists given a real-world problem.
- create a table of data that is applicable to the real-world situation.
- write an equation for direct variation.
- graph an equation representing direct variation.
- write an equation for inverse variation.
- calculate amount of discount and savings.

VI. REFERENCE/RESOURCE MATERIALS:
Graphing Calculator
Internet access

VII. PRIMARY ASSESSMENT STRATEGIES:
The task includes an assessment component that performs two functions: (1) for the student it will be a checklist and provide a self-assessment and (2) for the teacher it will be used as a rubric. The assessment list will be designed to also act as a rubric that the student can use as a checklist and then self-assess. The teacher will use this assessment list and rubric to assess the student's work.

VIII. EVALUATION CRITERIA:

- Performance Task Assessment List
- Task Rubric
- Benchmark of exemplary work

IX. INSTRUCTIONAL TIME:
One 90 minute class

I Want to Rock!

Strand
Algebra, Functions

Mathematical Objectives
Students will be able to:

- determine whether a real-world situation has a direct or inverse variation.
- create a table of data applicable to the given situation.
- name the constant of variation.
- write an equation for direct variation.
- write an equation for inverse variation.
- graph an equation representing direct variation.
- use the information about variations to answer questions in real-world context.
- calculate amount of discount and amount of savings.

Related SOL

- A.8 (analyze a relation to determine whether a direct or inverse variation exists, and represent a direct variation algebraically and graphically and an inverse variation algebraically)

NCTM Standards

- Build new mathematical knowledge through problem solving
- Apply and adapt a variety of appropriate strategies to solve problems
- Organize and consolidate their mathematical thinking through communication
- Create and use representations to organize, record, and communicate mathematical ideas
- Use representations to model and interpret physical, social, and mathematical phenomena
- Communicate their mathematical thinking coherently and clearly to peers, teachers, and others
- Recognize and apply mathematics in contexts outside of mathematics

Materials/Resources
Classroom set of graphing calculators
Access to computers for internet research

Assumption of Prior Knowledge
Students should be able to:

- represent verbal quantitative situations algebraically and evaluate these expressions for replacement values of the variables.
- graph linear equations in two variables.
- determine whether a direct or inverse variation exists, and represent a direct variation algebraically and graphically and an inverse variation algebraically.
- collect and analyze data using mathematical models.
- express what they consider to be significant savings and bargains. They will begin to speak as consumers.
- identify other real world examples of direct and inverse variation.
- use the internet as a resource for consumers.
- use their mathematical skills to analyze discounts and sales to make purchasing decisions.

Introduction: Setting Up the Mathematical Task

- In this task students will apply their knowledge of direct and inverse variation to solving real-world problems.
- Students will create a music playlist and choose an alternate website from which to download music besides *X*tunes. They will compare pricing and sales offered to determine the best deals. They will support their decisions mathematically through the use of data tables, graphs, and equations.
- The teacher will prompt task with questions like, "What type of music do you listen to?", "How many songs do you have on your MP3 players or cell phones?", "How much do you think you have spent on the music you have?", "If you don't have a cell phone or MP3, do you plan on getting one?", "Do you have to spend your own money to buy your devices and music?", "Do you have any money in savings?"
- The teacher will review the instructions and questions in the task. They will ask students to choose the best deal based on the playlist that they created. The teacher will instruct the students (in groups) to take 10 minutes and create a playlist with a minimum of 12 songs to begin the task.
- Students will work in groups to collaborate on the different goals within the task.
- The teacher may discuss and use the following as examples of direct and inverse variation to draw on students' prior knowledge:
  the distance you travel in your car compared to the gas in the tank
  the amount of pizza you get to eat compared to the number of people sharing the pizza
- Each student will be provided a rubric and checklist to review and clarify expectations.
- Students will discuss their discoveries during whole class discussion time following their work on the task.

Student Exploration

Small Group Work (ideally 3 students) (60 minutes)

- Students will be asked to spend 5 minutes reading through the task and discussing initial thoughts.
- Students should then work to complete all parts of task.

Whole Class Sharing/Discussion (30 minutes)

- Upon completion of task, have students share which company they chose to buy their music from and why, sharing mathematical justifications for their choices.
- Then have students share some what type of variations they found in their graphs/equations and justify their answers.
- Next discuss whether students found any constants of variation. Have groups share which situations gave them a constant and what constant they found.

Student/Teacher Actions:

- The students should be working together to create a playlist. Then, using songs from playlist, students should calculate costs and savings from *X*tunes.
- The students should research other music sites on-line and see if there is a way to save more than if they choose to go with *X*tunes.
- The students should create data tables, graphs and equations to represent their data.
- The students should determine if relationships are direct or inverse and what the constants of variation are. (Students could also go in the other direction – decide if direct or inverse, find the constant and then create equation and graph).
- The students should then answer all questions presented in the task and use good mathematical justification.

- The teacher(s) should be constantly monitoring the different group discussions. They may need to offer support to help group move forward by asking leading questions or giving examples of other direct and inverse variation real-life examples.
- The teacher(s) may ask, “Does the savings increase with the number of songs you buy or decrease?”, “Can you tell me any differences you noticed between the two *X*tunes graphs?”, “What do you notice happening between the number of songs you buy and the money you spend?”, “What do you notice about the number of songs you buy compared to the amount of money you have left?”
- The teacher(s) should check the reasonableness of the data student groups are choosing.
- The teacher(s) need to monitor that all group members are participating.
- The teacher(s) can encourage cooperation/collaboration by asking students to share how they have discussed a problem with each other before offering the answer or helping them begin a discussion with each other. Also teacher(s) can ask members from other groups to share some of the steps/discussion their group had with another struggling group before teacher offers answer.

Monitoring Student Responses

Teacher should expect:

- students to work together to create data, graphs, and equations on white boards (or SmartPals) before writing final representation on paper.
- students to talk to each other about justifications and predictions.
- students to verbalize with their group the thought processes behind representations and answers.
- students to ask questions of other groups about steps they may be struggling with (NOT ask for answers or to SEE graph/equation).

Task Summary

- Complete the Whole Class Sharing/Discussion portion listed above

Assessment List and Benchmarks

Performance Based Assessment Checklist

	0	2.5	5	Score
Student creates data tables	No data tables created	Incomplete/Incorrect data tables	Complete/Correct data tables with appropriate data to task	_____/5
Student creates graphs	No graphs created	Incomplete/Incorrect graphs (vertices not labeled, inaccurate intervals, data not graphed correctly)	Complete/Correct graphs (vertices labeled, accurate intervals, data correctly graphed)	_____/5
Student creates equations	No equations created	Incomplete/Incorrect equations	Complete/Correct equations	_____/5
Student represents constant of variation	No constant given	Incorrect constant	Correct constant	_____/5
Student determines direct or inverse variation	Wrong answer with no justification	Wrong answer with some justification/ Correct answer with no justification	Correct answer with good justification	_____/5
Student uses all of the above to answer task questions	No answers with no justification	Wrong answers with justification/Correct answers with no justification	Correct answers with good justification	_____/5

I Want to Rock! Rubric -(Students should be given both the PBA Checklist and rubric at the start of task so they fully understand expectations and are able to assess their own, and the groups, progress toward completion.)

Mathematics Performance Based Assessment Rubric – I Want to Rock!				
Process Goals for Students	4	3	2	1
Problem Solving and Reasoning	- Strategy was **very** logical, organized, and easy to follow. - Showed a **thorough** understanding of direct and inverse variation. - Showed a **thorough** understanding of discount, sale price and savings.	- Strategy was **mostly** logical, organized, and easy to follow. - Showed an **average** understanding of direct and inverse variation. (minor mistakes or gaps) - Showed a **moderate** understanding of discount, sale price and savings. (minor mistakes or gaps)	- Strategy was **somewhat** logical and **not easy** to follow. - Showed a **partial** understanding of direct and inverse variation.(several mistakes) - Showed a **partial** understanding of discount, sale price and savings. (several mistakes)	- Did not select a strategy. - Showed **little to no** understanding of direct and inverse variation. - Showed **little to no** understanding of discount, sale and savings.
Representations and Connections	- Created and used **correct** and accurate mathematical representations to record information and answer the questions in task. - Showed **correct** and accurate connections between different representations of data.	- Created and used **mostly correct** and accurate mathematical representations to record information and answer the questions in task. (minor mistakes or gaps) - Showed **mostly correct** and accurate connections between different representations of data. (minor mistakes or gaps)	- Made an **attempt** to use mathematical representations to record information and answer the questions. (inaccurate or incorrect) - **Attempted** to show some connections between different representations of data. (several mistakes or disconnect)	- Did not use mathematical connections to record information and answer the questions. - Showed **little to no** connection between different representations of data.
Communication	- Completely and clearly communicated **all** the steps in the groups' process of completing the task.	- Completely and clearly communicated **most** steps in the groups' process of completing the task. (minor gaps)	- **Partially** communicated **some** of the steps in the groups' process of completing the task. (major gaps)	- Communicated **little to none** the steps of the process. - Group was not able to work together.

Adapted from Virginia Department of Education, Fall 2012

I Want to Rock!

The website *X*tunes is running a special! Below is a snapshot of their homepage.

Create a playlist of the songs you want to purchase. Figure out how much it would cost to purchase at *X*tunes during the sale day and compare it to the cost if you bought the same list on a regular day. Create data tables and a graphs to support your findings.

Then, using another music download website, create a table and graph to show what buying and saving (if any) looks like for this company. (Do not use any free download website.)

- Who has the better deal?
- Can you come up with an equation for any of the graphs that would allow you to figure out cost no matter how many songs you bought?
- What type of relationship do you see? Support your answer.
- Can you give a constant of variation for any? Why or why not?

After completing the above to the best of your mathematical ability…answer these questions based on whatever music website you decided to order from:

- What type of relationship is going on between the amount of money you have and the number of songs you purchase? How do you know?
- Can you graph it and/or write an equation that would allow you to predict how much money you would have left no matter how many songs you bought?
- Can you find a constant of variation?

Benchmark – Student Exemplar (pages 8-12)

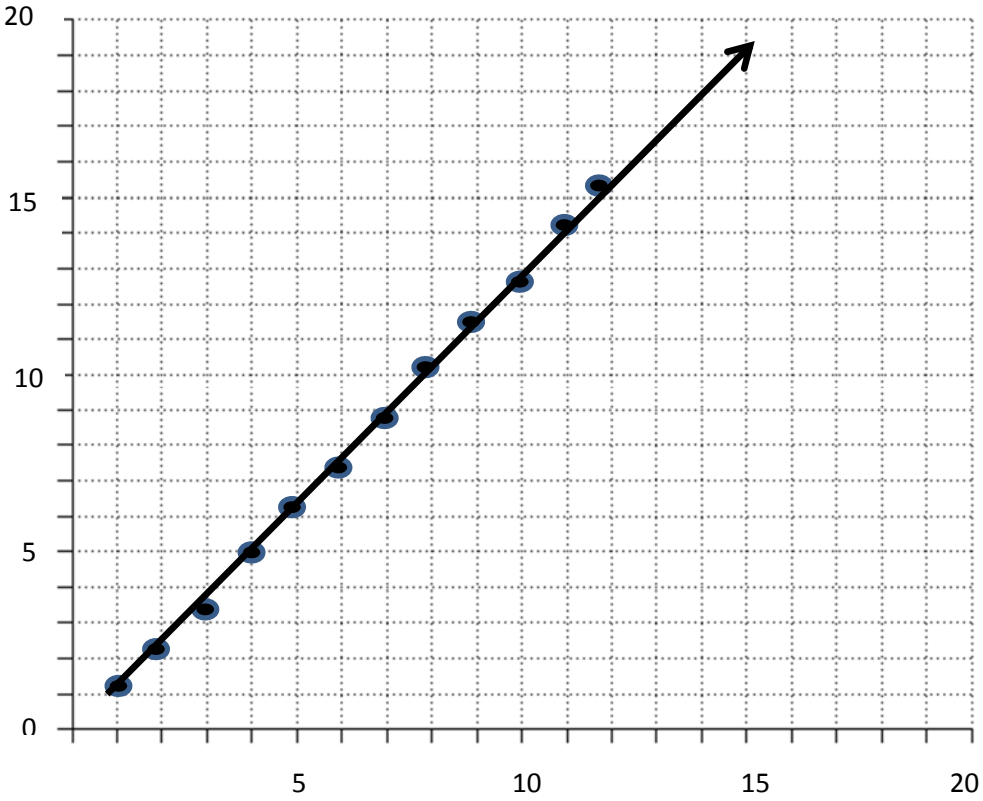
Xtunes' Regular Price

Number of Songs (x)	Song Title	Total Cost (y)
1	Bad Boys Having A Party	1.29
2	Happy	2.58
3	When Doves Cry	3.87
4	Love is Your Name	5.16
5	Blank Space	6.45
6	Put a Ring On It	7.74
7	September	9.03
8	Uptown Funk	10.32
9	Shut Up and Dance	11.61
10	Bad Blood	12.90
11	Your Love is King	14.19
12	Hey Mamma	15.48

Equation: $y = 1.29x$

constant of variation (k)

Direct Variation – because as the number of songs goes up so does the price.



Xtunes' One Day Sale

Number of Songs(x)	Song Title	Total Cost (y)
1	Bad Boys Having A Party	1.16
2	Happy	2.32
3	When Doves Cry	3.48
4	Love is Your Name	4.64
5	Blank Space	5.80
6	Put a Ring On It	6.83
7	September	7.86
8	Uptown Funk	8.89
9	Shut Up and Dance	9.92
10	Bad Blood	10.95
11	Your Love is King	11.79
12	Hey Mamma	12.63

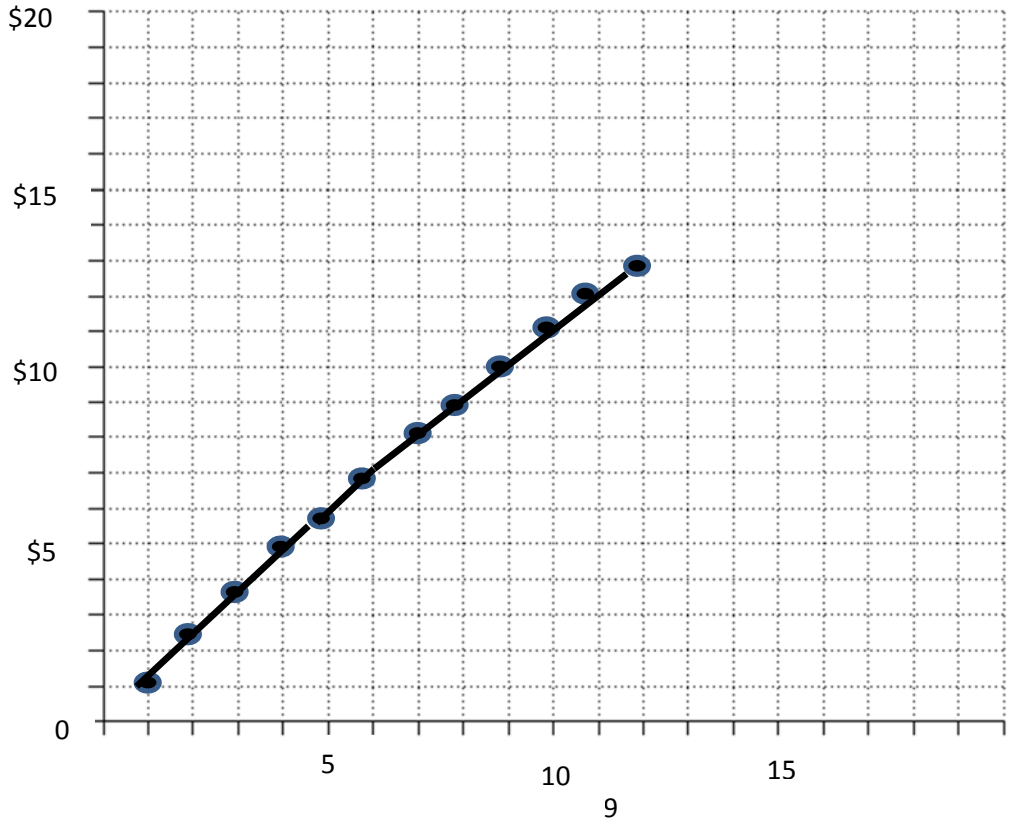
1st Five Downloads: $y = 1.29x - .10(1.29x) = 1.16x$

2nd Five Downloads $y = 1.29x - .20(1.29x) = 1.03x$

Remaining Downloads $y = 1{,}29x - .35(1.29x) = 0.84x$

no constant of variation because of the different rates

*(Students may run a linear regression and approximate a linear equation)



Graphically, it appears to be a direct variation because as the amount of songs increases so does the price.

Xtunes with a Collection

Number of Songs	Song Title	Total Cost	
1	Bad Boys Having A Party	**COLLECTION**	
2	Happy		
3	When Doves Cry		
4	Love is Your Name		
5	Blank Space		
6	Put a Ring On It		
7	September		
8	Uptown Funk		
9	Shut Up and Dance		
10	Bad Blood		$9.19
11	Your Love is King		1.29
12	Hey Mamma		1.29
TOTAL COST			$11.77

Collection: $12.25 - .25(12.25) = 9.19$

Based on individual song purchase: $15.48 - 12.63 = 2.85$

Savings based on the collection:

$15.48 - 11.77 =$3.71

We saved more with the collection.

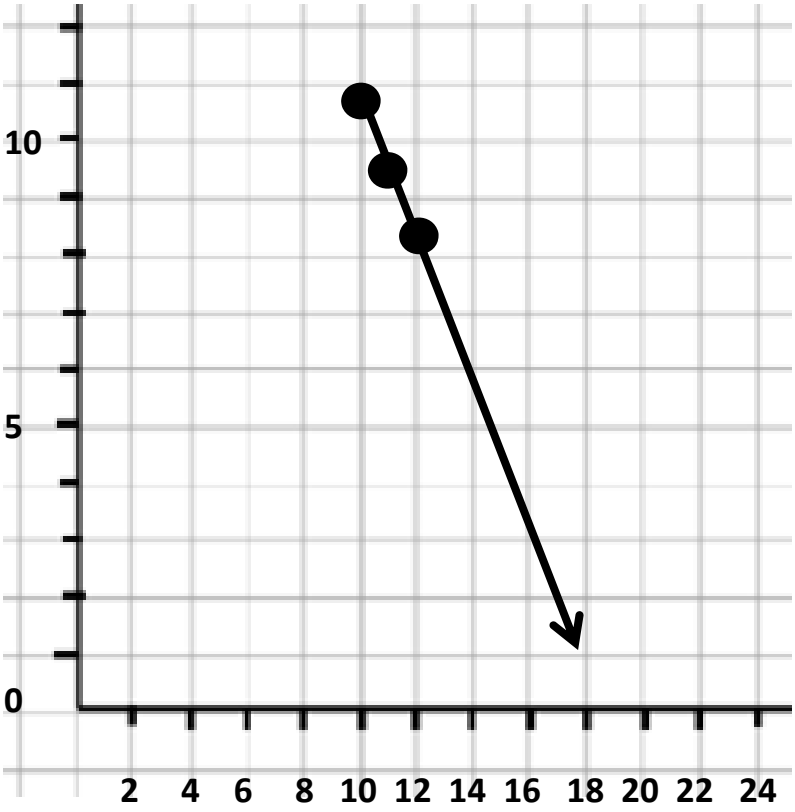
Amazing Music Downloads

Song Title	Song Price
Bad Boys Having A Party	0.99
Happy	0.99
When Doves Cry	0.99
Love is Your Name	1.29
Blank Space	1.29
Put a Ring On It	1.29
September	1.29
Uptown Funk	1.29
Shut Up and Dance	1.29
Bad Blood	1.29
Your Love is King	1.29
Hey Mamma	1.99
TOTAL	**$15.28**

The Xtunes One Day Sale was a better deal than my website, Amazing Music. However, Amazing Music is a better deal by $0.20 on a regular day.

Our group has $20.00 to spend on music. Based on the results, we are making our purchases during the *X*tunes one day sale and we will start with their collection special.

Number of Songs(x)	Total Cost	Money Left(y)
10	9.19	10.81
11	10.48	9.52
12	11.77	8.23



inverse variation* - as the number of songs goes up our money goes down.

$k = xy$

k = (10)(10.81) = 108.81

k = (10)(10.81) = 104.72

k = (10)(10.81) = 98.76

No constant of variation because of the changes in discount.

*Students may use linear regression to find equation

PBA Rubric

The following rubric and category descriptions will be used to assess your PBA. Please review the rubric carefully. You will turn in your self-assessment with each draft of the project.

Number	Element	Point Value	Self-Graded	Teacher Grade
1	The Template is complete	8	8	
2	All materials and answer keys for the task are included	8	8	
3	The Template and materials are organized and structured	8	8	
4	The task is inquiry based	4	4	
5	The task is connected to the real world	6	6	
6	The task requires higher order thinking skills/levels of cognitive demand	4	4	
7	The task is based on the SOL's and NCTM Standards	8	8	
8	The assessment is provided and is followed both by students and teacher	12	12	
9	The benchmark of exemplary student work is included	8	8	
10	The document is professionally presented as a PDF	6	6	
	Total	**72**	**72**	

Descriptions of each Category

Points will be awarded for each item that is provided within the category.

1. **The Template is complete**
    a. All nine Roman Numerals on the title page are completed
    b. All bolded items in the body of the template are completed
    c. The included information for each component is accurate
    d. All instructions are removed from the template

2. **All materials and answer keys for activities are included**
    a. Any activity has a worksheet or related document that shows how the information will be shared with students
    b. The activity documents are well structured with limited grammatical errors
    c. Answer keys are provided for all activities (Note: Open-ended tasks have "benchmarks," rather than answer keys.)
    d. The answer keys are mathematically accurate and well structured

3. **The Template and materials are organized and structured**
    a. The template and materials are easy to follow
    b. The template and materials have no grammatical errors
    c. The template and materials could be downloaded and used by another teacher with limited issues
    d. The template and materials are conceptually connected

4. **The task is inquiry based**
    a. The task focuses on students exploring mathematical concepts.

b. The tasks allows for students to build conceptual understanding.

5. **The task is connected to the real world**
    a. The task focuses on integrating a real world situation
    b. The task allows for students to connect the mathematical concepts to the real world situation
    c. The situation is not contrived, but is related to a literal understanding of a concept

6. **The task requires higher order thinking skills/levels of cognitive demand**
    a. The task requires students to analyze, evaluate, and or create mathematical meaning
    b. The task is either at higher cognitive demand levels: Procedures with Connections or Doing Math

7. **The task is based on the SOL's and NCTM Standards**
    a. SOL's are provided
    b. NCTM Standards are provided
    c. The appropriate standards are chosen
    d. There are no apparent missing standards

8. **The assessment is provided and is followed both by students and teacher**
    a. The assessment is in the form of a rubric
    b. A description is provided for how points are assigned each level of the rubric
    c. All essential mathematical concepts are included on the rubric
    d. All graded components are built into the rubric
    e. Both students and teachers are instructed to use the assessment
    f. Rubrics are free of grammatical/spelling errors

9. **The benchmark of exemplary student work is included**
    a. The benchmark shows how students would work each activity
    b. The benchmark shows how students would complete the assessment
    c. The benchmark shows exemplary work and is presented professionally
    d. The benchmark is mathematically accurate and represents the final product you would expect to be presented in your class

10. **The document is professionally presented as a PDF**
    a. Font formatting (size, style, type) is consistent throughout the document
    b. Bullets and other itemized lists are consistently formatted
    c. Individual page layouts are complete, with no partial or incomplete pages