LESSON DETAILS

Borrowing money... at what cost?

Lesson Summary

In this lesson, students examine the effect of various factors, such as interest rate, initial cost and amount of down payment, on the total cost of a loan for a large expense.

Grade: 9

Big Ideas

Make responsible financial decisions.

Learning Expectations

AA1. develop and explore a variety of social-emotional learning skills in a context that supports and reflects their learning in connection with the expectations across all other strands

- recognizing sources of stress that present challenges to mathematical learning

A1. apply the mathematical processes to develop a conceptual understanding of, and procedural fluency with, the mathematics they are learning

- Reasoning and proving
- Reflecting

A2. make connections between mathematics and various knowledge systems, their lived experiences, and various real-life applications of mathematics, including careers.

B3. apply an understanding of rational numbers, ratios, rates, percentages, and proportions, in various mathematical contexts, and to solve problems

B3.1 apply an understanding of integers to describe location, direction, amount, and changes in any of these, in various contexts.

B3.5 pose and solve problems involving rates, percentages, and proportions in various contexts, including contexts connected to real-life applications of data, measurement, geometry, linear relations, and financial literacy

C3. represent and compare linear and non-linear relations that model real-life situations, and use these representations to make predictions

C3.1 compare the shapes of graphs of linear and non-linear relations to describe their rates of change, to make connections to growing and shrinking patterns, and to make predictions

C4. demonstrate an understanding of the characteristics of various representations of linear and non-linear relations, using tools, including coding when appropriate

C4.1 compare characteristics of graphs, tables of values, and equations of linear and non-linear relations

D2. apply the process of mathematical modelling, using data and mathematical concepts from other strands, to represent, analyse, make predictions, and provide insight into real-life situations

D2.1 describe the value of mathematical modelling and how it is used in real life to inform decisions

F1. demonstrate the knowledge and skills needed to make informed financial decisions

F1.1 identify a past or current financial situation and explain how it can inform financial decisions, by applying an understanding of the context of the situation and related mathematical knowledge

F1.3 compare the effects that different interest rates, lengths of borrowing time, ways in which interest is calculated, and amounts of down payments have on the overall costs associated with purchasing goods or services, using appropriate tools

Cross Curricular Connections

There are connections to the BTT1O Introduction to Business course when discussing financial management.

Learning Goals and Success Criteria:

Learning goals can be reviewed and modified according to vision and instructional intent. Success Criteria can be reviewed and modified in collaboration with students.

LG1 - We are learning to make financial decisions about borrowing based on facts and data.

SC1 - I can determine the final amount required to repay my loan.

SC 2 - I can justify my choices in relation to my financial decisions.

LG2 - We are learning to solve problems involving percentages and decimals in a financial literacy context.

SC1 - I can use the results of calculations (percentages, decimal numbers, fractions and conversions) to solve problems related to borrowing.

SC2 - I can interpret information from a graph to better understand financial situations.

SC3 - I can determine how the value of a loan may increase by gathering information from a graph and analyzing it.

LG3 - We are learning about situations that benefit from the creation of a mathematical model.

SC1 - I can explain how mathematical models can help individuals make financial decisions.

LG3 - We are learning to use financial literacy vocabulary appropriately in context.

SC1 - I can use appropriate financial literacy vocabulary in various contexts.

LG5 - We are learning to collaborate with our peers to draw valid conclusions related to our mathematical thinking.

SC1 - I can justify my position while remaining open to the ideas of others.

SC2 - I can actively participate in discussions in the group.

CONSIDERATIONS THROUGHOUT THE LESSON

Differentiated Instruction and Universal Design for Learning

When forming groups, be sure to make them heterogeneous so that multiple perspectives are present during the activity. There is no one-size-fits-all approach to finances, and what works for one person may not work for another, and heterogeneous groupings help to emphasize this fact.

The teacher uses professional judgment in discussions of finances, and intervenes to get conversations back on track when necessary. This is a particularly important consideration when discussing finances, as it can be a very sensitive topic depending on the student's lived experience and current situation. It is also important for the teacher to recognize their own biases about finances and not be influenced by them when planning.

Use effective prompting and questioning, including verbal interaction techniques (e.g., Talk Moves) to support students who may benefit from breaking down a task into smaller pieces or who need help activating their prior knowledge.

It is a good idea to review financial vocabulary with students beforehand. A word wall in an accessible location that clearly demonstrates the connections between the terms is recommended. This will also help with the vocabulary activity in the Action portion of the lesson.

Vocabulary to be studied:
rate - interest rate, tax rate
payment - initial payment, monthly payment, down payment
financing
interest
amount - interest amount, tax amount, total amount
total cost

Assessment

Throughout the lesson, the teacher will listen to the students' mathematical discussions to confirm their understanding of the concepts being studied. The teacher may use the observation chart to record observations of the students' mathematical discussions.

Exit ticket

Peer evaluation in relation to the co-constructed success criteria.
Self-evaluation in relation to the co-constructed success criteria.

RESOURCES AND LEARNING ENVIRONMENT

Educator Resources Needed

A laptop and/or chromebook and internet access to use Google and Desmos online tools.

A copy of the observation chart

Student Materials Needed

A laptop and/or chromebook and internet access to use Google and Desmos online tools.

Learning Environment Considerations

To foster a positive emotional environment, when questions are asked in this activity, ensure that students are given sufficient time to think about their answers. Encourage the Think, Pair, Share strategy to promote mathematical conversations to help build students' confidence.

Financial literacy can be a sensitive topic, and it is possible that some students may be made aware of personal circumstances related to a financial situation close to them as a result of the conversations that will take place in this lesson. It is important that the financial data and situations are fictional scenarios to avoid students feeling targeted or judged in relation to their realities and experiences. The situation proposed in the lesson (borrowing money to buy a car) could easily be adapted to be more relevant to the students and their realities (e.g., in an environment where a car is not considered necessary or even desirable, the purchase could be a house). Tuition fees, apprenticeship fees, money borrowed to start one's own business, or an emergency purchase (such as an expensive appliance (refrigerator, furnace, etc.)) could also be used as a starting point, linking this lesson to courses in the areas of career pathways and entrepreneurship.

Students should feel safe at all times, but special attention is needed during financial literacy lessons. The teacher should circulate at all times and monitor conversations to ensure that the topic is developed in a respectful manner, bringing the conversation back on track when necessary.

It is suggested that this teamwork be done with heterogeneous groups in an appropriately arranged space.

LESSON CONTENT

Minds-On (15 minutes)

The teacher begins the lesson with a picture. Ask “What do you notice?” and “What do you wonder?” in relation to this image and record student thinking in a common space.

Anticipated responses :

- What was the value of the car when it was new?
- What is the make/model/year of the car?
- Is the price negotiable?
- Does the price include taxes?
- Do I have to pay the full amount at once?

This last anticipated response is the idea on which the lesson is based. The idea is to get students to think about the borrowing options associated with buying a car.

Explain to students that they will be asked to determine the monthly cost of financing the purchase of a car using a car payment calculator. Students will be separated into randomly selected groups so that they can look at several different possible situations, and then share the findings with the large group.

Action (45 minutes)

Place students in pairs (with one group of 3, if the class has an odd number of students). This pairing can be done randomly to ensure that the lesson runs smoothly.

Part 1

When talking about borrowing, we are introduced to important vocabulary. Now is a good time to review the specialized vocabulary that will be studied. To do this, all students will be given a paper or electronic copy of the vocabulary chart. On this sheet, there is a list of the financial terminology being studied. It also includes definitions and examples, but there is missing information! Students will now have to find the missing information. For definitions, students will have to infer the missing information using context clues related to the values provided. For missing values, students will need to perform calculations. It is important for teachers to walk around with their student tracking tool to capture the conversations that take place during this activity.

After taking the necessary time, return to the large group to share the answers. Do not proceed to Part 2 until there is consensus on the definitions developed by the class. Note to teacher - students may need support in refining definitions for completeness. This also creates a sense of ownership of the definitions that is not developed when looking them up in a dictionary or on the Internet.

Part 2

Give each pair a situation card to work with. The sequence of work should go as follows:

a) Read the situation cards and ensure understanding: Teachers should be available at this point to answer any questions related to the information being shared as they circulate and listen to students' conversations to ensure understanding. Note common student challenges to be discussed as a large group before continuing.
b) Predicting the effect of change: The situation cards contain two sets of data - a baseline situation, and a situation in which a variable was changed. Each pair will

have to apply the critical thinking process to predict the effect the change will have on the monthly car payment.

c) Calculate monthly payments: After making a prediction, students use the car buying calculator to determine the monthly payments of the two buying situations.
d) Response: Students record how they feel about the results, the validity of their prediction, and any other feelings they had during the activity.
e) Compilation: Students should compile their findings in the common compilation table. It may be important here to remind students of the expectations related to digital citizenship as all students are working in the same collaborative document.

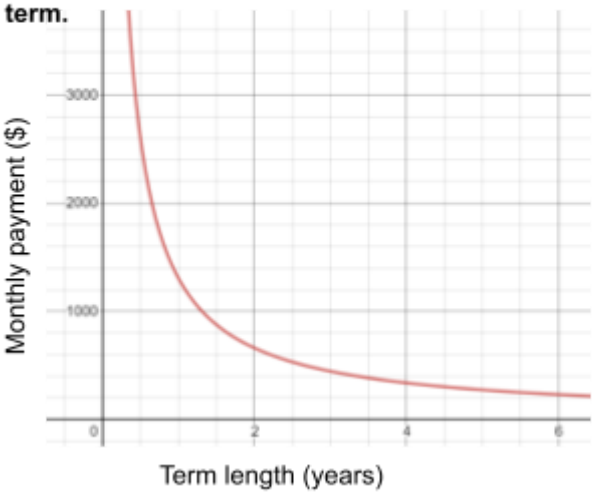
Have students review the compilation table. Teachers should remind students to observe what changes and what stays the same in each situation. After giving an appropriate amount of time (varies depending on group realities), ask the following questions:

a) What did you notice that surprised you?
    i) Anticipated answers (may vary):
        1) When the cost of the car is doubled, the total cost increases by more than double.
        2) If you take longer to pay for the car, the monthly cost decreases but the total cost increases drastically.
        3) If you double the initial down payment, the effect on the monthly payment is minimal.

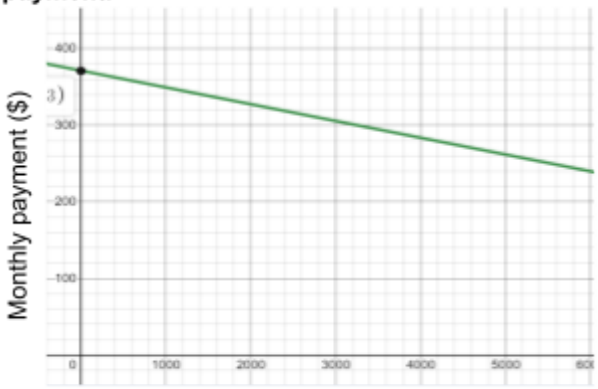
Here, the important thing is to have students realize that, even though the variables change by a factor of 2 (i.e., double or half), the effect on the monthly payment does not follow the same pattern. These are non-linear relationships.

To help students better understand the complex relationships of compound interest, divide students back into four groups (here, it may be preferable to divide the class into 8 or 12 and give some situations in duplicate so that the groups are not too large). Each group should be given a worksheet that represents a compound interest situation in which the relationship between the monthly payment and a variable is graphed, e.g., the initial payment, the value of the car, the interest rate, and the length of the term.

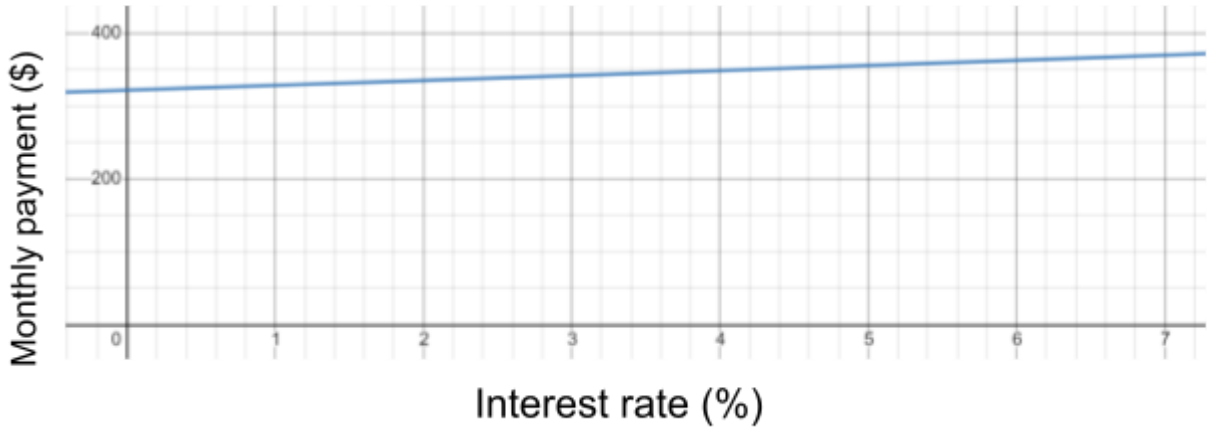
Graph of the relationship between the value of the monthly payment and the length of the loan term.



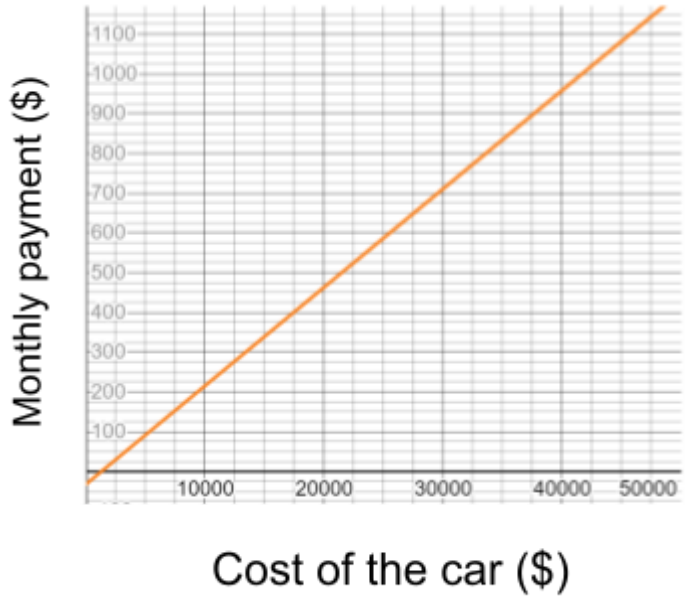
Graph of the relationship between the value of the monthly payment and the value of the initial payment.



Graph of the relationship between the value of the monthly payment and the interest rate



Graph of the relationship between the value of the monthly payment and the cost of the car



After allowing enough time for teams to have a discussion about their situation, use a sharing strategy like a gallery walk so that everyone in the class can become familiar with each scenario.

As a large group, ask the following questions :

- What variable has the greatest impact on the monthly payment?
- What situation surprised you the most?
- What questions should you ask the sales representative about costs when buying a car?

Extension Opportunities

There are a variety of ways to borrow money to purchase a vehicle. Students could choose to change more of the variables (e.g., variable interest rate, bi-weekly payment, etc.) to make the activity even more realistic.

Students could research current interest rates at car retailers and banks to add a greater element of realism to the activity.

The numbers used for situation cards use a factor of 2 - the variables that change are either doubled or reduced by half. What would happen to the monthly payment if a factor of 3 or 4 were used to change some of the variables?

In order to work with more complex interest systems and larger amounts of money, one can replace the purchase of a car with a mortgage and resume the activity with this new financial product.
Coding Extension: The student could use a spreadsheet (Sheets, Excel, etc.) or block coding software to create a new version of the car buying calculator with variables that are not part of the original version.

Consolidation (15 minutes)

Ask students to look at the chart again as a class. Is there a situation where the monthly payment is affected by a factor of 2 or a half? Ask students to consider why this is the case.

Ask students which is better, a monthly payment that is lower or a loan amount that is lower. Is there a right answer to this question? What factors should be considered in making a decision?

Now ask students to choose the situation that would be best for them and justify their answers. It is anticipated that the majority of students will attempt to choose the situation for which the amount of the loan or the monthly payment is the lowest. At this point, present students with the exit ticket. Ask students to answer the question, then debrief the answers the next day at the beginning of class. Allow students who wish to do so to share their answers and reasoning. This question could provide a variety of answers and a very rich conversation, but be careful of the biases associated with borrowing money.

Appendix 1

Link for the image

Appendix 2 -Situation cards

Car buying situation		
Sale price	**$15,000**	**$15,000**
Tax rate	**13 %**	**13 %**
Initial down payment	**$1,500**	**$3 ,000**
Number of months	**48**	**48**
Interest rate	**2.5 %**	**2.5 %**

Car buying situation		
Sale price	**$15,000**	**$15,000**
Tax rate	**13 %**	**13 %**
Initial down payment	**$1,500**	**$1,500**
Number of months	**48**	**96**
Interest rate	**2.5 %**	**2.5 %**

Car buying situation		
Sale price	**$15,000**	**$15,000**
Tax rate	**13 %**	**13 %**
Initial down payment	**$1,500**	**$1,500**
Number of months	**48**	**48**
Interest rate	**2.5 %**	**5.0 %**

Car buying situation		
Sale price	**$15,000**	**$30, 000**
Tax rate	**13 %**	**13 %**
Initial down payment	**$1,500**	**$3, 000**
Number of months	**48**	**48**
Interest rate	**2.5 %**	**2.5 %**

Car buying situation		
Sale price	**$15,000**	**$15, 000**
Tax rate	**13 %**	**6.5 %**
Initial down payment	**$1,500**	**$1, 500**
Number of months	**48**	**48**
Interest rate	**2.5 %**	**2.5 %**

Car buying situation		
Sale price	**$15,000**	**$15, 000**
Tax rate	**13 %**	**13 %**
Initial down payment	**$1,500**	**$750**
Number of months	**48**	**48**
Interest rate	**2.5 %**	**2.5 %**

Note - there are many possible combinations of data, so the six cards offered here are just the beginning of what is possible to explore in relation to this concept.

Appendix 3 - Joint compilation table

	Initial	1	2	3	4	5	6
Sale price	**$15, 000**						
Tax rate	**13 %**						
Initial down payment	**$1, 500**						
Number of months	**48**						
Interest rate	**2,5 %**						
Amount of financing	**$15, 450**						
Payment per month	**$338.57**						
Total cost	**$16, 251.45**						

Note - there are several possible combinations of data, so you may need to add columns for additional situations.

Appendix 4 - Exit ticket

Name :

_____

Date :

_____

Period/Goal : _____

Why would an individual choose one of the more expensive options to purchase their vehicle?

Name :

_____

Date :

_____

Period/Goal : _____

Why would an individual choose one of the more expensive options to purchase their vehicle?

Appendix 5 - Observation chart

Observation chart: Financial literacy

LG3 - We are learning to use financial literacy vocabulary in appropriate contexts.

- SC1 - I can use financial literacy vocabulary in appropriate contexts.

LG5 - We are learning to collaborate with our peers to draw valid conclusions.

- SC1 - I can justify my position while remaining open to the ideas of others
- SC2 - I can actively participate in discussions in the group.

P	Actively **p**articipates in group discussions
J	**J**ustifies his or her positions
O	Demonstrates **o**penness to the ideas of others
V	Uses financial literacy **v**ocabulary correctly

Date → **Names** ↓									
	PJOV	PJOV	PJOV	PJOV	PJOV	PJOV	PJOV	PJOV	PJOV
	PJOV	PJOV	PJOV	PJOV	PJOV	PJOV	PJOV	PJOV	PJOV
	PJOV	PJOV	PJOV	PJOV	PJOV	PJOV	PJOV	PJOV	PJOV
	PJOV	PJOV	PJOV	PJOV	PJOV	PJOV	PJOV	PJOV	PJOV
	PJOV	PJOV	PJOV	PJOV	PJOV	PJOV	PJOV	PJOV	PJOV
	PJOV	PJOV	PJOV	PJOV	PJOV	PJOV	PJOV	PJOV	PJOV
	PJOV	PJOV	PJOV	PJOV	PJOV	PJOV	PJOV	PJOV	PJOV
	PJOV	PJOV	PJOV	PJOV	PJOV	PJOV	PJOV	PJOV	PJOV
	PJOV	PJOV	PJOV	PJOV	PJOV	PJOV	PJOV	PJOV	PJOV

Appendix 6 - Vocabulary chart

Sale price		
Tax rate	The sales taxes that will be applied to the cost of the car, expressed as a percentage	
Tax amount		
Initial down payment	The payment to be made at the time of purchase	$2, 000
Amount of financing		$9, 300
Duration of financing	The expected length of time to pay the amount borrowed, expressed in months or years.	12 mo
Interest rate		5 %
Interest amount	The portion of the total cost that reflects the interest on the loan.	$253.79
Monthly payments	The amount of money to be paid per month.	
Total cost	The total amount the car will cost, including the down payment, taxes and interest	$9, 553.79

Appendix 6 - Vocabulary chart answer key

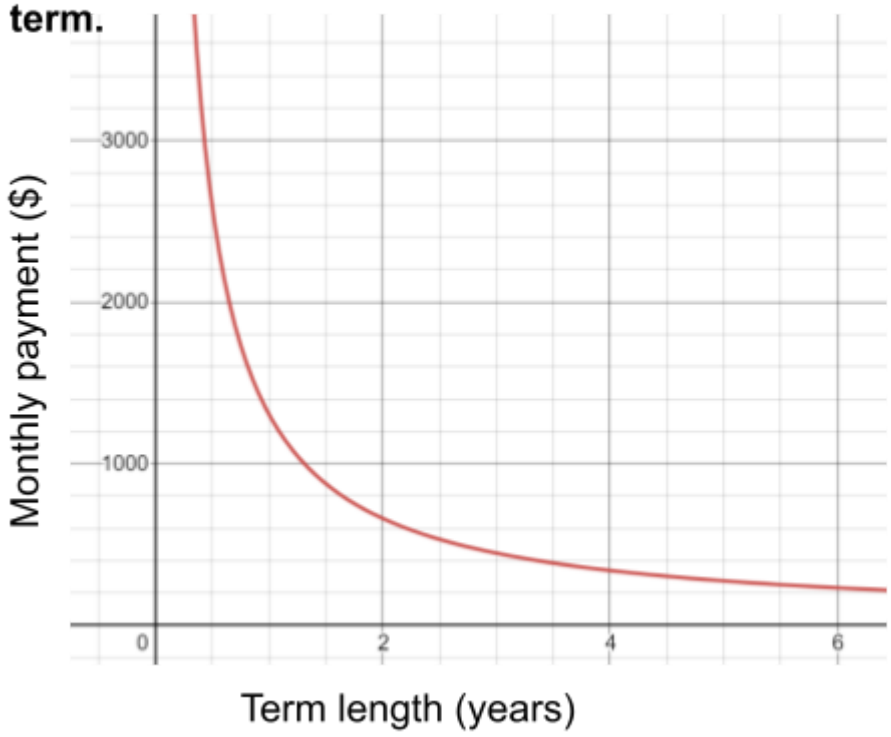
Sale price	The advertised cost or the cost on the car's label	$10, 000
Tax rate	The sales taxes that will be applied to the cost of the car, expressed as a percentage	
Tax amount	The amount associated with the tax rate applied to the sale price	$1, 300
Initial down payment	The payment to be made at the time of purchase	$2, 000
Amount of financing	The total amount that the car will cost, including taxes	$9, 300
Duration of financing	The expected length of time to pay the amount borrowed, expressed in months or years.	12 mo
Interest rate	The cost associated with borrowing the money, expressed as a percentage	5 %
Interest amount	The portion of the total cost that reflects the interest on the loan.	$253.79
Monthly payments	The amount of money to be paid per month	$796.15
Total cost	The total amount the car will cost, including the down payment, taxes and interest	$9, 553.79

Note - answers may vary for definitions to be completed by students.

Appendix 7 - Graph comparison chart

Group 1 - The effect of the duration of the term

Graph of the relationship between the value of the monthly payment and the length of the loan term.



Constants : Value of loan = $15,450 Interest rate = 2.5%.

According to the chart, what would be the advantage of choosing a 4-year term instead of a 6-year term?

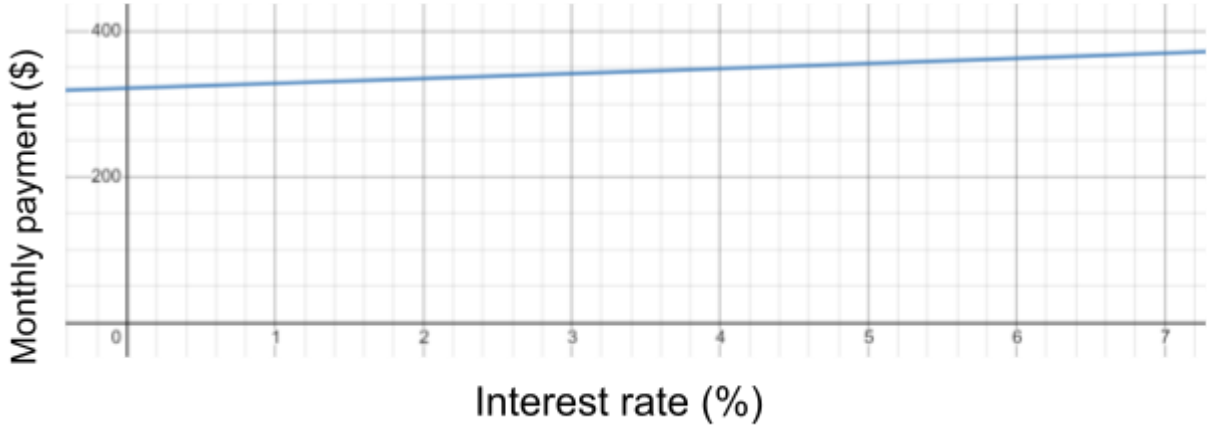
Answer :

Basing your reasoning on what you have observed in the graph, why do you think interest rates tend to be higher for longer terms?

Answer :

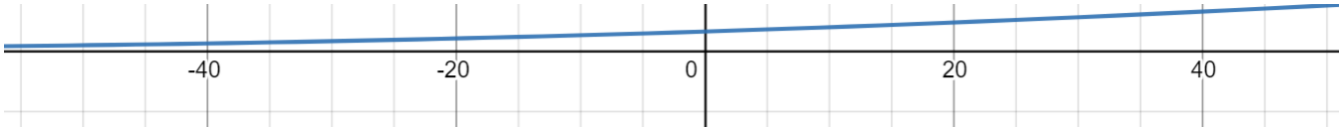
Group 2 - The effect of the interest rate

Graph of the relationship between the value of the monthly payment and the interest rate



Constants : Value of loan = $15,450 Term of loan = 4 years

This graph may be misleading. Looking at this close-up image of the graph, explain what is misleading about this graph.



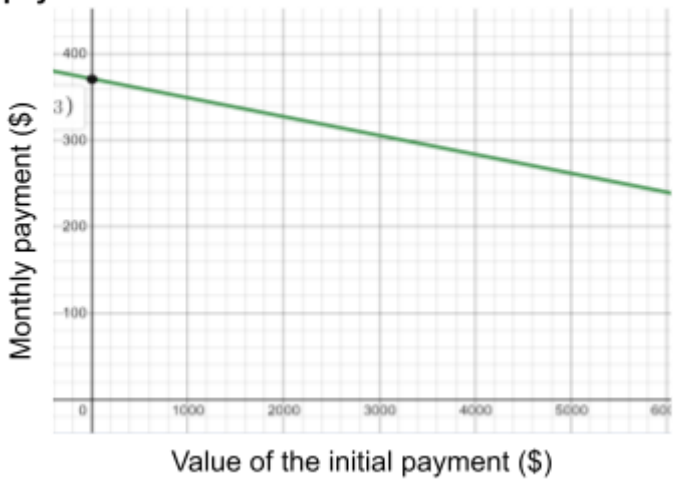
Answer :

Based on your observations, describe the effect of the interest rate on the monthly payment. Is it a significant or negligible effect?

Answer :

Group 3 - The effect of the initial down payment

Graph of the relationship between the value of the monthly payment and the value of the initial payment.



Constant : Initial payment = $1,500 Interest rate = 2.5% Term of loan= 4 years

What do the points where the line intersects the x-axis and the y-axis mean?

Answer :

A doubling of the initial payment does not reduce the monthly payment by half. Explain why this is the case.

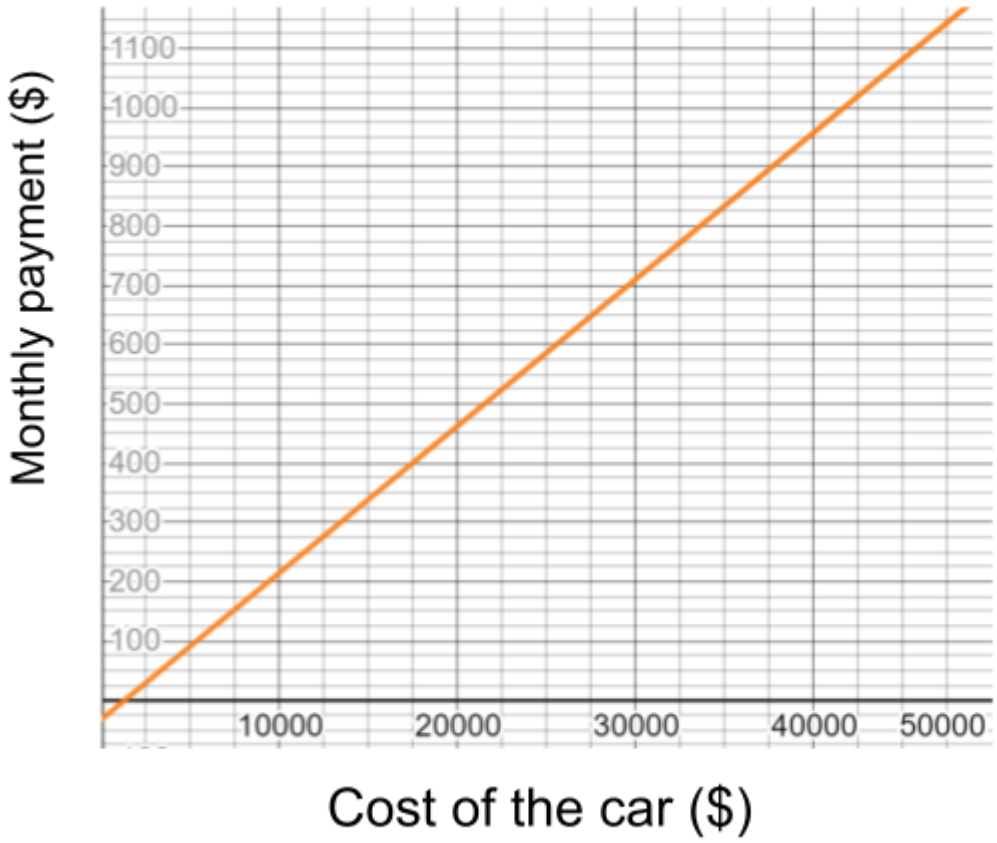
Answer :

What does the rate of change tell us about this relationship?

Answer :

Group 4 - The effect of the cost of the car

Graph of the relationship between the value of the monthly payment and the cost of the car



Constant : Initial payment = $1,500 Interest rate = 2.5% Term of loan = 4 years

This line does not pass through (0,0). Why is it impossible for this line to pass through (0,0)?

Answer :

What value is represented by the point of intersection between the line and the x axis? How do you know this?

Answer :