# Bad investments

Students explore the depreciation formula to investigate whether cars are a good investment.

Students will need at least one digital device per pair during this lesson to research and interact with Excel spreadsheets.

## Visible learning

### Learning intentions

* To be able to calculate the depreciated value of an asset.
* To understand the declining balance method of depreciation.

### Success criteria

* I can explain what is meant by the term ‘depreciation’.
* I can calculate the depreciated value of an asset using the declining balance depreciation formula.
* I can explain the connection between compound interest and declining balance depreciation.
* I can justify why some asset’s values decrease rapidly when new.

### Syllabus outcomes

A student:

* develops understanding and fluency in mathematics through exploring and connecting mathematical concepts, choosing and applying mathematical techniques to solve problems, and communicating their thinking and reasoning coherently and clearly **MAO-WM-01**
* solves financial problems involving compound interest and depreciation **MA5-FIN-C-02**
* identifies connections between algebraic and graphical representations of quadratic and exponential relationships in various contexts **MA5-NLI-C-01**

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Table 1: lesson summary

|  |  |  |  |
| --- | --- | --- | --- |
| Section | Summary of activity | Teaching strategy | Teaching points  |
| Launch | Students watch a short video (4:47) (<https://bit.ly/newcarspoor>) and discuss why new cars lose value so quickly. | Think-Pair-Share | The purpose of this activity is to spark curiosity. |
| Explore | Students find the value of a new car and enter it into the spreadsheet and discuss if the car is depreciating by the same amount each year. Students are also presented with a graph of the 2 depreciation models (*Bad investments* PowerPoint) and asked what they notice and wonder. They then consider which method they would use as a tax deduction. | Think-Pair-ShareNotice and wonder | The purpose of this activity is to explore and compare depreciation using a linear model and an exponential model. |
| Summarise | The depreciation formula is introduced and applying the formula is taught explicitly.Students complete the questions from [Appendix A](#_Appendix_A) in groups on vertically non-permanent surfaces. | Worked examples (Your turn)Visibly random groups of 3Vertical non-permanent surfacesGallery walkTAG proforma for peer feedback | The purpose of this activity is to explicitly teach the depreciation formula and have students practise finding different variables. |
| Apply | Students look at 5 different big investment items and their values in 2022 versus 2024. Students complete the table in [Appendix B](#_Appendix_B).Students discuss a negative rate of depreciation. | Notice and wonderGallery walkPose-Pause-Pounce-Bounce | The purpose of this activity is for students to look at different assets and how they change compared to a car. |

## Activity structure

Please use the associated PowerPoint *Bad investments* to display images in this lesson.

### Launch

1. Show students the video ‘How Cars Keep You POOR!’ (4:47) (<https://bit.ly/newcarspoor>) until 1:32.
2. In a Think-Pair-Share ([bit.ly/thinkpairsharestrategy](https://bit.ly/thinkpairsharestrategy)), ask students to consider why new cars lose value so quickly.

Some reasons new cars lose value so quickly include the arrival of newer models, better features, colour choice, wear and tear, and consumers would not buy a used car if it were the same value as the new car, they would buy it new.

1. Tell students that this is called depreciation and that we will be exploring it in this lesson.

This is the first time students may have been introduced to the term depreciation. Depreciation is defined in the syllabus as a decrease in value due to wear and tear, decay, decline in price, and so on.

### Explore

1. With at least one device per pair, ask students to find the price of any new car.
2. Direct students to the Excel spreadsheet Bad investments and enter the price of the new car into cell C5.

If devices are not available teachers could project the spreadsheet for students and enter different car values.

1. In a Think-Pair-Share, ask students to actively voice what they notice and what they wonder ([bit.ly/noticewonderstrategy](https://bit.ly/noticewonderstrategy)).
2. Students will construct a scatter graph of their data using the Excel spreadsheet graphing tool.
3. Pose the questions to the class: Is your car depreciating by the same amount each year? Is there a relationship between how much the car depreciated by each year?
4. In a Think-Pair-Share, have students work together using the data and the graph to collect evidence to justify their responses.

Students should conclude that the difference between each value is not the same and that the graph is not a straight line, therefore the car is not depreciating by the same amount each year.

1. Show slide 3 of the PowerPoint which contains a graph modelling depreciating by a constant amount and uses the depreciation formula. Ask students what they notice and what they wonder about the 2 data sets.

Students might notice that method 1’s value is constant while method 2’s value is very high initially but gets smaller as the years progress. Students might wonder why 2 methods exist or what equation would represent each method.

1. Ask students if they have seen graphs similar to this.
2. Display slide 4 of the PowerPoint showing a compound interest graph alongside a depreciation graph.
3. Discuss with students what they notice and what they wonder, drawing out that the graphs have the same shape but are a reflection of each other.
4. Again, referencing slide 3 of the PowerPoint inform students that this graph is modified from the ATO (Australian Tax Office) website ‘Prime cost (straight line) and diminishing value methods’ ([bit.ly/atodepreciationgraph](https://bit.ly/atodepreciationgraph)), as depreciation can be claimed as a work expense. Taxpayers are presented with a choice of which method of depreciation they would like to use in their tax return.

Students were introduced to tax-related work deductions in Lesson 8 – the secrets of keeping more money of Unit 5 – financial mathematics. It is important to note that cars can only be depreciated when owned by a company.

1. In a Think-Pair-Share, have students consider which method they would use and why.

This is an open question; students may choose the straight-line method as it is consistent, whereas students may choose the declining balance method as they get more money back at the start.

Students should also be prompted to consider which method provides the students with more money and why.

### Summarise

1. Display slide 6 of the PowerPoint to model the depreciation formula.
2. In pairs have students discuss the self-explanation prompt questions.

Students should make connections between this formula and the compound interest formula. Students may need both formulas written together to make this connection.

1. Use slides 7–10 of the PowerPoint for explicit teaching using the worked examples (Your turn) method ([bit.ly/supportingstrategies](https://bit.ly/supportingstrategies)) of using the depreciation formula.
2. Assign students into visibly random groups of 3 ([bit.ly/visiblegroups](https://bit.ly/visiblegroups)) on vertical non-permanent surfaces ([bit.ly/VNPSstrategy](https://bit.ly/VNPSstrategy)). Distribute Appendix A ‘Complete the table’ on A3 paper in plastic pockets to each group.
3. Students are to work together to complete the table.
4. Allow students time to do a gallery walk ([bit.ly/DLSgallerywalk](https://bit.ly/DLSgallerywalk)) and give peer feedback using the TAG proforma ([bit.ly/TAGstrategy](https://bit.ly/TAGstrategy)).
5. Students are to return to their groups and adjust their tables based on the feedback provided.

### Apply

1. Display slide 12 of the PowerPoint Bad investments for students, which shows Table 2.

Table 2: 2022 versus 2024

|  |  |  |
| --- | --- | --- |
| Other investments | 2022 | 2024 |
| iPhone 13 | $1087 | $879 |
| Google Pixel 7 Pro | $1299 | $599 |
| Median house price Cessnock | $532 475 | $590 000 |
| Median house price Orange | $713 500 | $831 769 |
| Toyota Land Cruiser (VX model) | $119 000 | $122 000 |

1. Using Table 2, have students discuss what they notice and what they wonder about the 5 different investments.

Students might notice that some investments have gone up in value and some have gone down. They might notice that the car has gained value.

Students may wonder by what percentage each has changed.

1. Still working in their groups of 3 distribute Appendix B ‘Other investments’ on A3 paper in plastic pockets and have groups complete the activity, the first one is done for the students.
2. After students have made some progress allow students time to do a gallery walk to compare their solutions, working out and reflect on any changes they may need.
3. Initiate a sharing of ideas and reasoning using the Pose-Pause-Pounce-Bounce questioning strategy (PDF 557 KB) ([bit.ly/posepausepouncebounce](https://bit.ly/posepausepouncebounce)) to unpack the following questions:
* What does a negative depreciation rate mean?
* Why are my 2 rates different?

Negative depreciation is appreciation. The 2 rates are different because one is linear and the other is exponential.

1. Ask students to consider the 5 items in the table and the cars from the explore section of the lesson and justify whether they think cars are a good or bad investment in relation to their depreciation over time.

This is an open-ended question with no set response. Good or bad investments are personal choices dependent on many factors.

## Assessment and differentiation

### Suggested opportunities for differentiation

**Launch**

* There are many correct answers during the launch, and all students should be encouraged to participate and share their thoughts and reasoning.

**Explore**

* A notice and wonder strategy is used where there is no correct answer, so that all students can participate in the discussion.
* Students may need to be reminded of tax deductions and how they affect individuals’ tax returns.

**Summarise**

* Less-ready students may need some revision on changing percentages to decimals.
* Students may benefit from first revising solving equations. Solving equations was explored in Lessons 5–7 of Unit 10 – expressions and equations.
* Students who are ready may use logarithms to solve equations with the unknown as the power, otherwise students would use the guess and check method or graphical method.

**Apply**

* Teachers could provide students with the rate and ask them to use the depreciation formula to confirm the rate is correct.

### Suggested opportunities for assessment

**Explore**

* The teacher could monitor students’ responses to why the graph is or isn’t depreciating by the same amount to assess Working mathematically.

**Summarise**

* Monitor student responses in the ‘Your turn’ section to check for understanding of using the depreciation formula to find salvage value.
* Students provide peer feedback on Appendix A about learning intentions and success criteria.

**Apply**

* Create an exit ticket with a car depreciation question to provide evidence of the student’s understanding of applying the depreciation formula.
* The justification could be collected and used as a summative assessment of Working mathematically.

## Appendix A

### Complete the table

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Salvage value | Initial value | Rate of depreciation | Number of years | Working |
|  | 32 000 | 20% | 5 |  |
|  | 56 000 | 18% | 7 |  |
| 15 086 |  | 15% | 6 |  |
| 22 664 |  | 10% | 10 |  |
| 60 790 | 78 500 |  | 2 |  |
| 27 414 | 62 450 |  | 3 |  |
| 48 270 | 92 470 | 15% |  |  |

## Appendix B

### Other investments

|  |  |  |  |
| --- | --- | --- | --- |
| Product | Change in dollars | Percentage change | Rate of depreciation |
| iPhone 132022 value= $10872024 value= $879 | Change | Percentage change Per year |  |
| Google Pixel 7 Pro2022 value=$12992024 value=$599 |  |  |  |
| Median house price Cessnock2022 value=$532 4752024 value= $590 000 |  |  |  |
| Median house price Orange2022 value=$713 5002024 value= 831 769 |  |  |  |
| Toyota Land Cruiser (VX model)2022 value= $119 0002024 value= $122 000 |  |  |  |

## Sample solutions

### Appendix A – complete the table

|  |  |  |  |
| --- | --- | --- | --- |
| Salvage value | Initial value | Rate of depreciation | Number of years |
| 79 626 | 32 000 | 20% | 5 |
| 13 960 | 56 000 | 18% | 7 |
| 15 086 | 40 000 | 15% | 6 |
| 22 664 | 65 000 | 10% | 10 |
| 60 790 | 78 500 | 12% | 2 |
| 27 414 | 62 450 | 24% | 3 |
| 48 270 | 92 470 | 15% | 4 |

### Appendix B – other investments

|  |  |  |  |
| --- | --- | --- | --- |
| Product | Change in dollars | Percentage change | Rate of depreciation |
| iPhone 132022 value= $10872024 value= $879 | Change | Percentage changePer year = 9.5% |  |
| Google Pixel 7 Pro2022 value=$12992024 value=$599 | Change | Percentage changePer year = 26.9% |  |
| Median house price Cessnock2022 value=$532 4752024 value= $590 000 | Change | Percentage changePer year = 5.4% |  |
| Median house price Orange2022 value=$713 5002024 value= $831 769 | Change | Percentage changePer year = 8.3% |  |
| Toyota Land Cruiser (VX model)2022 value= $119 0002024 value= $122 000 | Change | Percentage changePer year = 1.25% |  |

## References

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