

Pricing for Profit

Lesson 1: A simple model

Australian Curriculum: Mathematics (Years 7 - 9)

ACMNA174: Investigate and calculate 'best buys', with and without digital technologies (Year 7)

ACMNA176: Create algebraic expressions and evaluate them by substituting a given value for each variable (Year 7)

ACMNA189: Solve problems involving profit and loss, with and without digital technologies (Year 8)

ACMNA208: Solve problems involving direct proportion. Explore the relationship between graphs and equations corresponding to simple rate problems

- identifying direct proportion in real-life contexts (Year 9)

Lesson abstract

Working in the context of selling toys and biscuits at a school fair, students meet specialist terms, such as 'profit'. They develop a spreadsheet and graph to model how profit depends on the number of items sold and the selling price. They consider underlying assumptions and how varying these will lead to a more sophisticated model, developed in later lessons.

Mathematical purpose (for students)

A mathematical model can be represented in words, graphically, in a table or with algebra.

Mathematical purpose (for teachers)

The purpose of this lesson is for students to think carefully about the context, describing it with specialist terms and concepts such as 'pricing' and 'profit'. They develop a simple direct proportion model, and represent it numerically and graphically and algebraically. This is an excellent opportunity for students to use spreadsheets, which is an important real life skill and ideal for use later in this unit. Take the opportunity of this relatively easy lesson to refresh or teach the necessary spreadsheet skills

This lesson should be preceded ideally by Unit 1 Introduction to Modelling, or by the 'QuickStart' lesson packaged with this unit.

Lesson Length 45 minutes approximately

Vocabulary Encountered

- profit
- mathematical model

Lesson Materials

- Slide show: ST7_Pricing_1a.pptx
- [Student Sheet 1 - Pricing for Profit](#) (1 per student)
- Access to spreadsheets (desirable throughout unit)

We value your feedback after these lessons via <https://www.surveymonkey.com/r/J8GPD7Z>



Lesson structure

- Whole-class discussion: Considering the school fair context (10-15 minutes)
- Collaborative small-group work: Modelling sales and profit (25-30 minutes)
- Whole-class discussion: Reflection on the model and the modelling cycle (10 minutes)

Considering the context

Show students slide [The school fair](#) and handout [Student Sheet 1 - Pricing for Profit](#).

Explain to students that they will work within the scenario of selling wooden animals and Anzac biscuits at a school fair, where the profit they make will go to charity.

Introduce the class to the problem that is central to the whole unit: developing a model that will provide insight into how to decide on the price to charge if we want to make a profit.

Ensure that students know that profit is the amount of money received minus the amount spent on 'production' and selling.

Ask "what factors will influence how much profit Jack and Megan make?"

Expected Student Responses

- The main factors influencing the profit are the cost to make the products, the price charged, and the number sold.
- Factors such as "how long it takes to make the biscuits" are part of the cost to make the products.

Tell students that to develop a first simple model we will assume that Jack and Megan are not going to consider the cost of production. They will use offcuts of wood and donated ingredients for the biscuits and work for free. Assume there are no costs involved in the selling. All the money coming from sales can be counted as profit.

Have a brief discussion about why we often first make a simple model when modelling, and emphasise that it means we can get started by developing a simple model that will provide some insight into the type of mathematics we need, before making the model more sophisticated.

The school fair

re(Solve)

Jack and Megan plan to raise money at the school fair:

- They plan to sell wooden toys and Anzac biscuits
- The money they raise will go to charity

How much money should they charge for each animal and pack of biscuits to make the biggest profit?

Modelling sales and profit

In this next phase of the lesson students work on developing a mathematical model that will allow them to **predict** how much profit will be made if they sell a certain number of wooden animals and/or a certain number of biscuits. Explain that mathematical models are usually used to make predictions. They will have experienced this in Unit 1.

Organize students into small groups (2-4 students).

Show slide [How much profit?](#)

Tell students they need to develop models that will allow them to answer questions such as:

- How much total profit will Jack and Megan make if they price each of the animals and each biscuit at \$1, \$2, \$3, and so on?
- How much profit Jack and Megan they make if they sell 10, 20 30 animals or biscuits?

Enabling Prompts

- Make a table that gives the profit if an animal costs \$1 and you sell 10, 20, 30 etc.?
- What about if an animal is sold for \$2, \$3....and so on?
- Work on biscuits and animals separately, to allow for the prices being different.

How much profit?

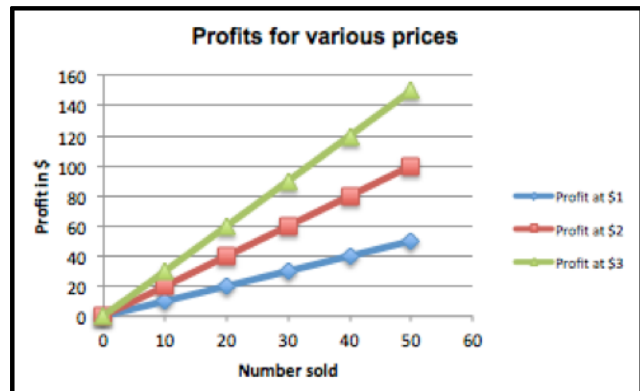
re(Solve)

- Develop a mathematical model that will allow you to **predict** how much profit will be made if Megan and Jack sell a certain number of wooden animals and a certain number of biscuits.
- Organize your results in a table, draw a graph and write in words or algebra how to make the predictions

Encourage students to represent their model as a table, a graph, or a rule in words or algebra (Slide: [Profits for various prices](#))

Expected Student Responses

Number sold	Profit at \$1	Profit at \$2	Profit at \$3
0	0	0	0
10	10	20	30
20	20	40	60
30	30	60	90
40	40	80	120
50	50	100	150



SAMPLE RULE IN WORDS:

If the cost is \$1 per item, to find the total profit you multiply the profit per item by the number you sell.

Enabling Prompts

When students have drawn a graph, to help them express their model algebraically (i.e. the relationship between the profit and the number sold using algebra) you could ask them:

- What shape is your graph?
- What is the gradient (slope) of your graph?
- What would make it steeper/shallower?
- Let s be the selling price of one biscuit/animal and n be the number sold.

Expected student responses

- When the selling price is \$3, the profit in dollars is equal to three times the number sold.
- If n is the number sold, s is the selling price and P is the profit, then $P = ns$

Show the slide [Pricing for profit](#)

Ask students to write a few brief sentences about what they have found/what they know.

Collect and share different representations

Extending prompts

- Students who do this task easily can include other factors in their model, such as the cost of ingredients or for making an advertising poster. There are many ways to extend, some of which are considered in the next lessons.
- How do you find the total profit from selling animals and biscuits if the process might be different?

As students work, take the opportunity to refresh or introduce the required spreadsheet skills.

re(Solve)

Pricing for profit

- Write a few brief sentences to describe what you have found/what you know.
- Describe this using mathematical words and symbols?

Reflection on the model and modelling cycle

Choose some of their representations to share with whole class. Make sure that you include tables, graphs, words and algebra. You should have two distinct parts to the conversation: one focussing on mathematical structure and the other on mathematical modelling.

Highlight, using questioning, the features of each representation that points to the underlying structure of direct proportion that is fundamental to the model. Draw attention to the connections between the different features of each representation that demonstrates proportionality (e.g. the table is going up in equal steps and this relates to the constant gradient of the straight line, how to make a big profit).

Have a short discussion to remind students that they are working on a real-world problem, and show the slide [Mathematical modelling](#).

Ask students to think about the modelling cycle.

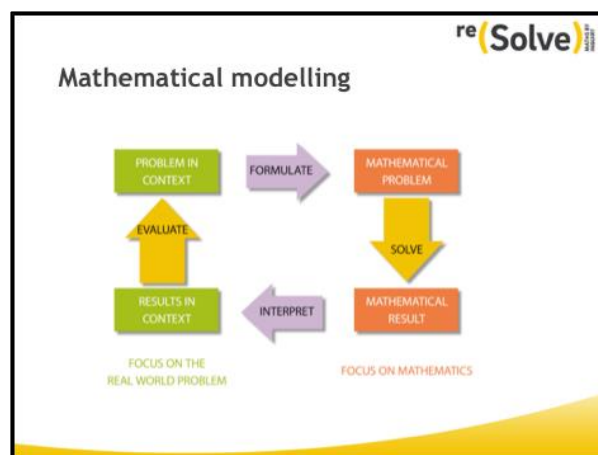
Discuss what have they been doing in terms of the modelling cycle. This could include questions such as:

- What parts of the modelling cycle have we been working on?
- How realistic/unrealistic are our models?
- What are the limitations of our models?
- How do you think we should improve our models?

Explain that in future lessons we will begin to take into account other factors: they will make their models more sophisticated as their current models does not take 'real life' into account sufficiently well.

For example, remind students that Jack and Megan will make the most profit if they sell a lot of animals and biscuits at a high price. Is this realistic?

Ask students whether they think Jack and Megan should aim to sell 1000 animals and biscuits at \$100 each? People are unlikely to buy them at that price. It is this sort of issue we need to consider next lesson.



Jack and Megan plan to make wooden toys to sell at the school fair.

The money they raise will go to charity.

They will use offcuts of wood that they have been given for free.



Megan and Jack also plan to make Anzac Biscuits to sell at the school fair.

The money they raise will also go to charity.

They will use ingredients that they have been given for free.

How much should they charge for each animal and pack of biscuits to make the biggest profit?

Calculate how much profit they will make if they price each of the animals and each pack of biscuits at \$1, \$2, \$3, and so on?

How much profit will they make if they sell 10, 20 30 animals or packs of biscuits?

Organize your results in a table and draw a graph

Use a spreadsheet if available.

- Express in words the relationship between the profit and the number sold.
- Express using algebra the relationship between the profit and the number sold.

Write a few sentences to describe what you have found.