

Unit Overview: Pricing for Profit

Summary of learning goals

This unit is based on the scenario of making wooden animals and biscuits to sell for charity. The main goal is that students increase their understanding of the mathematical modelling process, by experiencing it directly, and by linking their work to the mathematical modelling cycle. There is a special focus on the formulation phase, with a series of scenarios highlighting identifying variables, and selecting and generating relationships between variables. The unit begins with constructing a very simple direct proportion model, assuming that profit depends only on the number of items sold, and the selling price. This model is refined to consider the effect of increased sales price on number of sales, and hence on profit, with a resulting quadratic relationship. Further refinement using a spreadsheet enables a range of values for the parameters to be considered and the inclusion of other factors such as the cost of materials. Finally, students consider processes for validation of the model and good report writing.

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)

ACMNA180: Investigate, interpret and analyse graphs from authentic data (Year 7)

ACMNA194: Solve linear equations using algebraic and graphical techniques. Verify solutions by substitution (Year 8)

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

ACMNA296: Graph simple non-linear relations with and without the use of digital technologies and solve simple related equations (Year 9)

ACMNA 294: Find the midpoint and gradient of a line segment (interval) on the Cartesian plane using a range of strategies, including graphing software (Year 9)

AC SIS169 and AC SIS203: Analyse patterns and trends in data, including describing relationships between variables and identifying inconsistencies

- Using spreadsheets to present data in tables and graphical forms and to carry out mathematical analyses on data.
- Exploring relationships between variables using spreadsheets, databases, tables, charts, graphs and statistics. (Years 9 and 10)

Summary of lessons

Who is this Unit for?

The essential mathematics for these lessons comes from Years 7 and 8 Australian Curriculum: Mathematics. More advanced content in algebra can be used by some students. The aim is to develop students' understanding of how to use their mathematical knowledge to solve practical problems. When students who are undertaking this as their first unit in mathematical modelling, it should be preceded by the Introductory lesson

ST7_Modelling_QuickStartLesson.pdf, packaged with this unit. The ability to use a spreadsheet for tables and graphs is an advantage, but pre-prepared files are supplied. Some students could use complex formulas in their spreadsheets. Lesson 5 stands apart from the sequence to highlight the formulating phase of modelling. This stand-alone lesson can be taught at any stage of the unit, or within any of the other *Mathematical Modelling* units.

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



Lesson 1: A simple model

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.

Lesson 2: Improving the model

Students refine their model from Lesson 1 by addressing one major unrealistic assumption they made: that the number of sales is independent of selling price. They consider possible relationships between selling price and sales and derive (quadratic) relationships between price and profit.

Lesson 3: Better models with spreadsheets

Students refine their models and implement them as spreadsheets. First, they make a spreadsheet where sales decrease as price increases for any linear decreasing pattern, and observe the effect of assumptions such as how many people buy at a given price. Then they include production costs in the model, and optionally make increasingly automated spreadsheets. There are good opportunities to use algebra.

Lesson 4: Reflecting on modelling

Students choose the model they think is best, and work in pairs to write report, critique the report of another pair and revise their reports in the light of their peers’ critique. They reflect on the process of modelling and consider the wider applicability of the model they have developed.

Lesson 5: Formulating models

Students focus on how to formulate models. First, students identify variables that are important in making a choice of what coffee to buy. Second, students select relationships between variables that might best model the likely spread of a bushfire. Third, they generate relationships to model various situations, graphically and algebraically.

Reflection on this unit

Rationale

These lessons provide a structured approach to develop modelling skills. A key message is to begin with a simple model and gradually refine it to take account of more variables. This approach enables students to get started, and emphasises the importance of identifying variables and making simplifying assumptions. Lesson 5 provides three short exercises that highlight subskills of the formulation process.

reSolve Mathematics is Purposeful

This unit reveals how modelling has a two-fold purpose. It can be used to answer a specific real world query, but the unit also demonstrates the use of modelling to understand typical behaviour of real world systems. Students see how the simplest model shows profit as being directly proportional to selling price, but more realistic models reveal how there is often an optimum selling price, to maximise profit.

reSolve Tasks are Inclusive and Challenging

These lessons allow students to use different levels of mathematics and make spreadsheets of varying complexity. Some students may work only numerically, most will begin numerically and move to some algebra later, and a few might work algebraically from the start. Various supports are provided, such as pre-prepared spreadsheets.

reSolve Classrooms Have a Knowledge Building Culture

The lessons use whole class discussion and small group discussion extensively. Some techniques for including all students, ground rules for students to follow and techniques for assisting students to share their reasoning and explanations are described in the *Teachers’ Guide for Mathematical Modelling* included in this package