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Using financial modelling to decide "Should I tap into my superannuation?"

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This article argues the importance of teaching students about the philosophical and mathematical underpinnings of Australia's superannuation system as an example of a real-world problem context. It also provides a rationale for teaching financial modelling and decision-making in ways that respect the diverse financial realities represented in Australian classrooms.

Background

Did you know that around 30% of Australian 15–19-year olds attending school full time are also formally employed (Australian Institute of Family Studies, 2017) ? They work in retail sales, fast food outlets and cafes, and in community sports coaching roles. This means that many secondary school students are already receiving superannuation payments in preparation for their retirement.

It was following the last economic recession in 1990–91 that the Australian government introduced the Superannuation Guarantee—an economic policy that requires employers to pay a minimum percentage of each employee's earnings to a superannuation (or 'super') fund. At the time, the government predicted that it would be unable to support an ageing population in retirement (around 15% of the total population are now aged 65 and over (Australian Institute of Health and Welfare, 2018))—it needed to reduce reliance on the Age Pension. The Superannuation Guarantee was intended to help all Australians by boosting national savings and paying for personal living costs upon retirement.

With the COVID-19 health crisis presenting an even more severe economic and financial crisis, some Australians have become eligible to access $10 000 to $20 000 of their super. The offer to access savings in super aims to help those experiencing unemployment and financial hardship solve cash flow difficulties. It acknowledges that for some, immediate access to cash to meet essential expenses will trump watching super savings accumulate towards retirement. So how might one decide whether or not to take advantage of this offer?

Mathematical modelling

Mathematical modelling is the process of using mathematics to generate practical insights into real world situations (Brown & Stillman, 2017). People create mathematical models to describe, explain and/or predict the behavior of complex systems (English et al., 2005; Stacey, 2015). More than ever before, modelling promotes the value of mathematics as a critical tool for analysing and understanding important global and local issues—including personal financial matters. Mathematics teachers have an important role to play in preparing school leavers who can draw on their mathematical knowledge, skills and proficiencies to prepare mathematical models that can contribute to informed financial decision-making.

At school, mathematical modelling is a conceptual process that involves students working together to engage with a problem situation and each other. Multidisciplinary in nature, the process of mathematical modelling involves more than traditional problem solving (Doyle, 2006; Lesh & Harel, 2003). It gives students opportunities to:

- apply mathematical thinking to develop a deeper functional understanding of authentic problems;
- interpret information embedded in a problem to determine relevant features and elements (variables);
- engage in iterative cycles of testing, retesting and refining ideas;

- represent their thinking in a variety of formats including text, graphs, tables, diagrams, spreadsheets, and orally;
- produce accurate predictions or estimates of the problem situation, or about the future or past states of modelled systems;
- evaluate the usefulness of the model.

Stillman, Brown and Geiger (2015) argue that it is through mathematical modelling that "students are drawn into the articulated thinking, reasoning, manifestation of beliefs about modelling and mathematics and confidence in mathematical knowledge and ability to use this, of others within the group" (p. 97). In other words, students' ability to translate a real-world problem into a mathematical problem occurs through collective reasoning and activity.

Broadly, mathematising real world problems is a two-fold process. It requires students to access their embodied knowledge and lived experiences of the real-world context to make sense of the situation (Ekici & Alagoz, 2020). It then requires students to analyse the situation mathematically (Stacey, 2015). Figure 1 depicts a model of a mathematical modelling cycle. Based on other models and refined for use in framing the OECD's Programme for International Student Assessment (PISA), this model has also been used to describe students' financial problem-solving and decision-making within primary school mathematics lessons (Sawatzki & Sullivan, 2017; Sawatzki, Downton, & Cheeseman, 2019). We suggest that it may be equally useful to secondary school teachers.

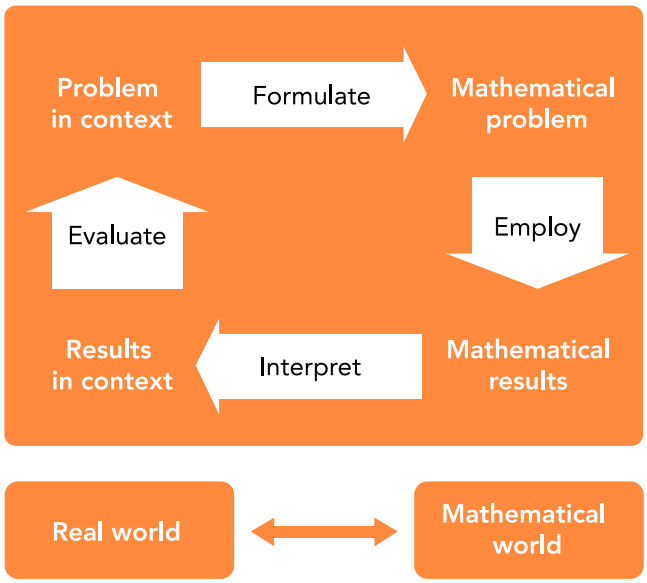

Figure 1. PISA 2012 model of mathematical modelling (OECD, 2017).

The model is divided into two sides: the real world (left) and mathematical world (right). The arrows illustrate the processes for how students move between (Formulate and Interpret) and within (Employ and Evaluate) the real and mathematical worlds (Stacey, 2015). During the formulation process, the student reasons about and makes sense of constraints and assumptions to simplify the problem and identifies the relevant mathematics to represent the situation. Next, the student employs knowledge, skills and technology to solve the problem mathematically, and then interprets the solution to make sense of the situation. Finally, the student evaluates the appropriateness of their answer in its real-world context. If the answer is not suitable, it can be revised through the cyclical nature of the model, although Stacey (2015, p.63) notes that "in reality, problem solvers can make many movements back and forth rather than steadily progressing forward through the modelling cycle".

Financial literacy and financial modelling

In this article, we refer to mathematical modelling as an umbrella term and financial modelling as mathematical modelling processes applied to financial contexts so as to develop financial literacy. Research has shown that financial literacy learning is enhanced when mathematics teaching is strategically situated in financial contexts that students deem to be useful to their lives beyond school (Sawatzki, 2018). However, finding meaningful contexts can be difficult. Students are the ultimate judge whether a problem is appealing enough to attempt to solve, and they make this judgement based on the level of difficulty they perceive in the problem, their interest in it, and the importance they ascribe to it (Borasi, 1986).

Researchers have identified a number of characteristics of high-quality problem contexts, which include that a context should:

- support the mathematics (Meyer, Dekker & Querelle, 2001);
- be real or at least imaginable (Sawatzki, 2017);
- allow the making of models (Stillman, Kaiser, Blum, & Brown, 2013);
- be sensitive to social and cultural norms (Hunter & Sawatzki, 2019); and
- not exclude or marginalise any group of students (Blue & Grootenboer, 2019);

While working with unfamiliar problem contexts is inevitably more demanding for teachers and students, research suggests that students value these opportunities (Sawatzki, 2017). For example, Yoshimura and Yanagimoto (2013) observed that mathematical (financial) modelling tasks like the one presented in this article "aroused students' curiosity, encouraged students to open up society more and boosted awareness as members of society" (p.250).

In line with the above thinking, we work together to identify the sorts of financial decisions young people might face beyond school and create financial mathematics lessons that enable students to not only practice financial problem-solving, but come to understand how

personal and government decisions can impact individuals, families, communities and society. Lessons like these show students that doing mathematics is helpful and informative to economic, financial and civic participation.

In designing the lessons that are the focus of this article, we predicted that students may have been privy to family conversations and practices related to superannuation, as well as media reporting about the recent option to access savings in super. The lessons explore the sorts of calculations that are useful to those considering accessing their savings in super, with a focus on articulating assumptions, developing mathematical models, and reasoning proportionally. The lessons also require students to engage in critical and creative thinking, as they weigh the short- and long-term trade-offs associated with altering one's superannuation plan.

We acknowledge there is a range of digital 'solutions', including online calculators and apps, that can undertake complex financial computations with speed and accuracy, but argue it remains important to teach students the mathematical knowledge and skills that inform how these are programmed. It is only through developing financial models and practicing creating digital tools like spreadsheets that students become confident to use these to make informed decisions about investments.

The task: Who should tap into their superannuation?

The task presented in Figure 2 has been designed to encourage students to think about living costs and how people might manage their income and expenses and make important financial decisions during challenging economic times.

Advice to teachers about the task

Students will need to think about Matt and Riley's individual circumstances. Students should identify the variables they need to include in their model and enter these into a spreadsheet. Then they should use publicly available information and personal knowledge to make financial assumptions for each of the variables and justify their choices. This will include researching the Job Keeper scheme.

Students will need to consider and research each person's living costs. For example, housing, utilities such as electricity and telecommunications, food, groceries, and other costs. Average household costs are available on the internet or by speaking with family members. It would be reasonable to expect that Riley's 'fixed' living costs are higher since he has two children, and that Matt has more disposable income (or 'variable' costs). A sample budget is

Preparing a financial model to investigate cashflow

Matt and Riley are both 35 years old and have worked as flight attendants with Qantas for many years. Normally, they earn $6,325 every month (before tax). Both Matt and Riley have been stood down during the coronavirus pandemic and are receiving JobKeeper payments of $1,500 per fortnight. Matt owns his own home with a mortgage but does not have a partner or children. Riley is a single parent of two children aged 3 and 5 and rents an apartment. When Riley travels for work his parents help look after the children.

Like all employers in Australia, Qantas pays a minimum percentage of each employee's earnings to a superannuation (or "super") fund. Superannuation is a form of investment that pays for personal living costs upon retirement.

Due to the pandemic, some people are eligible to access money from their superannuation —up to $10,000 until 30 June 2020 and up to a further $10,000 from 1 July until 24 September 2020.

How would you advise Matt and Riley?

- What are the variables and assumptions?
- Use a spreadsheet to create a model that depicts the relationship between the variables you have identified for both Matt and Riley.
- Who should tap into their superannuation? Which variables seem to matter most?

Reference

https://www.ato.gov.au/Individuals/Super/In-detail/Withdrawingand-using-your-super/COVID-19-early-release-of-super/

Figure 2. Who should tap into their super?

Modelling a monthly budget

Monthly costs	Matt	Assumptions	Data source
Housing	$1700	Living in Melbourne; bank reduced monthly payment	www.choice.com.au/guides/
Food	$400	$13 per day. Eating at home, supermarket & takeaway	www.budgetdirect.com.au
Groceries	$200	$50 per week of essential supplies	
Transport	$0	Staying at home, walking, cycling	
Electricity	$90	Usage by one person	www.energymadeeasy.gov.au
Gas	$0	No gas connected	
Phone	$25	Post-paid plan, didn't change	
Other	$200	Estimated	
Monthly costs	**$2615**		

Figure 3. Example of budgeted cost of living for Matt.

provided for Matt in Figure 3, including the monthly costs (variables), assumptions made and financial value for each variable, and sources of information to justify the assumptions.

Next students will need to compare each person's income and possible savings against their costs to decide if money should be withdrawn from superannuation. If Matt or Riley's monthly income is not enough to cover their costs, then students might look at whether either person could cut costs. If Matt or Riley's monthly income is still not enough to cover their reduced costs, the student should decide how much to recommend that Matt or Riley take from super and justify their recommendation. A sample comparison of Matt and Riley's budgets is provided in Figure 4. In this model, we have assumed that Matt negotiated a lower mortgage repayment with his bank and reduced his discretionary spending, however Riley was supporting two dependents and had higher costs that were more difficult to cut.

Comparison of monthly budgets

Monthly income	**Matt**	**Riley**
Jobkeeper payments	$3000	$3000
Monthly income after tax	**$2700**	**$2700**
Monthly costs	**Matt**	**Riley**
Housing	$1700	$2000
Food	$400	$975
Groceries	$200	$250
Transport	$0	$0
Electricity	$90	$120
Gas	$0	$30
Phone	$25	$25
Other	$200	$450
Monthly costs	**$2615**	**$3850**
Income less costs	$85	–$1150

Figure 4. Sample comparison of Matt and Riley's financial position during the pandemic

Based on the sample comparison of Matt and Riley's budgets, it looks like Matt will not need to dip into his super, but Riley will need to take some money out to cover his family's costs over the next few months. This might be influenced by how much Riley has in savings to bolster his JobKeeper payments and how long students think it will be before Qantas flights return to 'normal'. Some people are more risk averse and may prefer to take money out of super and have it sitting in a readily accessible bank account so that they have some money in case of an additional emergency. Assuming Riley expects to receive JobKeeper for six months and then return to his normal income, and he has no savings, Riley will be short $6 900 (= 6 × 1,150) due to the impact of the pandemic. Students may suggest that Riley should apply to take $10 000 out of his super to cover his costs and put the rest ($3100) in the bank as an emergency fund.

Enabling prompts:

- How long will Matt and Riley's normal income be affected?
- What is their JobKeeper income after tax?
- What are Matt and Riley's current living costs?
- Can Matt or Riley trim some of their costs during the pandemic?
- Do they have any cash savings they could use to bolster their reduced income?
- How long will their JobKeeper income and current savings enable them to cover their costs?
- Are they eligible to withdraw money from their super?

Extending prompts:

- Should Matt or Riley withdraw money from super and, if so, how much? Convince me.
- How much money do they currently have saved in superannuation?
- What will be the long-term impact of withdrawing this money from super by the time they retire at 67 years old?

Possible curriculum connections

Consumer and financial literacy feature explicitly in the *Australian Curriculum: Mathematics*. The Number and Algebra content strand includes 'money and financial mathematics' as a sub-strand from Years 1–10 (ACARA, 2019a). There are significant opportunities to develop students' knowledge, skills and capabilities for financial problem-solving and decision-making beyond the money and financial mathematics sub-strand. The Numeracy capability specifies that students learn "to apply mathematical understanding and skills in context, in other learning areas and in real-world contexts" with a particularly important context for the application of number and algebra being financial mathematics (ACARA, 2019b). Numeracy teaching and learning can be embedded in any learning area—in this case, Humanities and Social Sciences: Economics & Business, where there is the expectation that students be taught the content through contemporary issues, events and/or case studies as they learn to apply economics and business concepts to make informed decisions (ACARA, 2019c). The task also requires students to discuss their thinking and link their reasoning to the general capabilities of Critical and Creative Thinking and Personal and Social Capability.

Important pedagogical considerations

1. Invite students to share what they know and understand about the current economic crisis and the opportunity available to some to access savings in super.
2. Encourage students to work in small groups and expect the mathematical modelling process to be messy. Encourage students to check their mathematical models against the problem context (case studies). Do their calculations and interpretations make sense in the real world?
3. Avoid giving students values-laden advice about what makes a "wise" financial decision. Instead use questions that require them to draw on mathematics to guide their thinking. Examples include: "What are your reasons for making that decision?" and "What would someone who disagreed with you say?"
4. You might promote discussion about a "future orientation". This is the tendency to consider future consequences and a willingness to delay gratification in favour of longer-term goals.
5. Reflecting on the potential impact of personal financial decisions on individuals, families, communities and society can reveal insights into students' socioeconomic realities. These can be sensitive conversations.

Reflect and discuss with your colleagues

The ideas contained in this article can raise a number of challenges for teachers: the first being enacting the pedagogies associated with mathematical modelling and non-routine problems; and the second being dealing with the sensitive and often confronting nature of teaching financial literacy.

For support addressing the first issue, refer to the *reSolve: Maths by Inquiry* special topic Mathematical Modelling (Australian Association of Mathematics Teachers, 2020). This is a free high-quality teacher resource that offers helpful advice, units of work and teaching materials for teachers who are new to the teaching of mathematical modelling. Pedagogical approaches such as eliciting student reasoning through targeted questioning, structuring productive mathematical discussions, approaches to differentiation, and assessment are addressed. The resource can be accessed through the *reSolve* website https://www.resolve.edu.au/mathematical-modelling

In regards to the second issue, it can be useful to consider the funds of knowledge students bring to school from home. The funds of knowledge approach argues that by simply going about their everyday lives, all people accumulate knowledge and skills that are embedded in their social and cultural practices (Llopart & Esteban-Guitart, 2016). These can be specific to students' ethnic, family and community context. What opportunities do your students have to observe and experience financial matters within their families and communities? What economic and financial issues are important to your students? Challenge your personal assumptions and thinking about students' financial circumstances and habits—how do you know?

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