TAX AND SUPERANNUATION:
DEVELOPING PROPORTIONAL REASONING

Carly Sawatzki, Deakin University and Simone Zmood, Monash University

Taxation and superannuation contributions help all Australians by paying for essential services such as healthcare, education, infrastructure, transport and community services, as well as personal living costs upon retirement from the workforce. This article argues the importance of teaching students about the philosophical and mathematical underpinnings of Australia's taxation and superannuation systems and encourages schools and teachers to consider ways to do this as they develop students' ability to reason proportionally in Years 7-10.

POSSIBLE CURRICULUM CONNECTIONS

Given the strong correlation between mathematics and financial literacy achievement (OECD, 2017), mathematics teachers have an important role to play in preparing financially literate citizens capable of solving money-related problems and making informed decisions. 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.

RESEARCH INSIGHTS

Student learning is enhanced when mathematics teaching is strategically situated in financial contexts that students deem to be meaningful and useful to their lives beyond school (Sawatzki, 2018). This relies on finding interesting, if not novel, ways to connect students' learning about money within families and communities with their formal opportunities to become financially literate at school.

Classroom research exploring upper primary students' financial problem-solving and decision-making has shown that students make various social and cultural arguments when faced with worded money-related mathematical problems, and these arguments can influence the way they apply mathematics when solving tasks (Hunter & Sawatzki, 2019; Sawatzki & Sullivan, 2017; Sawatzki & Goos, 2018). Given Australia's tax culture, we predict that students may have been privy to family conversations and practices related to tax and super, including tax minimisation strategies like paying cash, making tax-deductible purchases and making voluntary pre-tax superannuation contributions.

Sawatzki and Goos (2018) argue that if teachers are to effectively attend to the issues and misconceptions that seem to contribute to mathematical error, they need to be aware of the potential impact of language and literacy on students' ability to adequately deal with financial problems and make informed financial decisions. This means that the language that is specific to, but also shared between Mathematics and HaSS: Economics & Business must be explicitly explored and developed.

Sawatzki, Downton and Cheeseman (2019) identify that over the course of their schooling, students develop the ability to reason proportionally as they learn to use fractions, decimals, percentages, ratios and rates. They argue that these conceptual understandings are essential to navigating the goods and services tax (GST), Australia's individual income tax scale, and compound interest calculations applied to superannuation and that proportional reasoning can be productively developed through such financial contexts.

SUGGESTED MATHEMATICS TASKS FOR YEARS 7-10

In line with the above thinking, Table 1 presents a range of mathematics tasks that we have created. These tasks intend to develop secondary students' thinking about taxation and superannuation, from calculations that take place behind the scenes to considering how personal and government decisions about tax and superannuation impact on individuals, families, communities and society. Tasks like these show students that doing mathematics is helpful and informative to economic, financial and civic participation. Each of these tasks also encourages engagement with three of the general capabilities in the Victorian Curriculum: critical and creative thinking, personal and social capability, and ethical understanding.

The tasks are listed in Table 2 on page 13. They can be downloaded from the MAV website using the link supplied after the references on page 12.

IMPORTANT PEDAGOGICAL CONSIDERATIONS

- Invite students to share what they know and understand about tax and super. They may be working and therefore paying tax and receiving super contributions.
- Make sure students record their mathematical working and their explanations.
- Ask students to convince you that their solutions are mathematically sound.
- Remind students to check the appropriateness of their solution against the problem, as well as any potential impact on individuals, families, communities and society.

TAX AND SUPERANNUATION:
DEVELOPING PROPORTIONAL REASONING (CONT.)

WHERE CAN I FIND MORE RESOURCES?

The Australian Taxation Office (ATO) also has a school education program which aims to teach students the basics of tax and super, the importance of paying tax and the benefits of the taxation system to the community. Tax, Super + You is a free online educational resource mapped to the Australian Curriculum. It consists of four modules that explore the Australian taxation system, personal and business tax topics, and the superannuation system. Free presentations are also offered to secondary school teachers and students at their school or via webinar.

REFLECT AND DISCUSS WITH YOUR COLLEAGUES

Table 1 shows the levels of government and their taxes.

FEDERAL (AUSTRALIAN/ COMMONWEALTH)	STATE OR TERRITORY	LOCAL
Income tax	Payroll tax	Property rates
Medicare levy	Stamp duty	Rubbish disposal charges
Company tax	Land tax	Building permits
Goods and services tax (GST)	Special purpose levies	Fines
Fringe benefits tax (FBT)	Taxes on gambling	Animal licences for pets
Capital gains tax (CGT)		
Customs duty on imports		
Excise on fuels, tobacco and other goods		
Departure tax at airports		
Petroleum resource rent tax		
Special purpose levies		

Table 1. Levels of government and their taxes (Reprinted with permission. [ATO, n.d., p. 8]).

Does this list help you to think of other tax and super related mathematics tasks that your students might find meaningful and useful? We'd love to receive your feedback and ideas!

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DOWNLOAD THE TASKS

There is one task for each year level. Use the link below and the table contains links to each task.

www.mav.vic.edu.au/Services-and-News/MAV-Journals/Journal-resources

YEAR LEVEL	LEARNING TASK	CURRICULUM CONNECTIONS
YEAR 7	**Is paying tax good or bad?** Explore calculating GST on a product or included in the final retail price. Discuss the fairness of flat rate taxes.	**Number and Algebra: Real numbers** • Find percentages of quantities and express one quantity as a percentage of another, with and without digital technologies. (VCMNA248). • Recognise and solve problems involving simple ratios. (VCMNA249).
YEAR 8	**Can a sugar tax lower rates of obesity?** Interpret the impact of a sugar tax by analysing the change in sales volume of different drink categories. Discuss the pros and cons of changing behaviour through higher prices.	**Statistics and Probability: Data representation and interpretation** • Identify everyday questions and issues involving at least one numerical and at least one categorical variable, and collect data directly from secondary sources (VCMSP324). • Compare data displays using mean, median and range to describe and interpret numerical data sets in terms of location (centre) and spread (VCMSP326).
YEAR 9	**How does career interuption impact taxation paid and superannuation saved?** Collect data on career interruptions and calculate the implications for tax and super based on the average Australian wage.	**Number and Algebra: Money and financial mathematics** • Solve problems involving simple interest (VCMNA304). **Number and Algebra: Patterns and algebra** • Apply set structures to solve real-world problems (VCMNA307).
YEAR 10	**How much is enough superannuation?** Calculate the super accumulated over 50 years and the impact of making voluntary contributions. Discuss how the costs of living change at different stages of life.	**Number and Algebra: Money and financial mathematics** • Connect the compound interest formula to repeated applications of simple interest using appropriate digital technologies (VCMNA328). **Number and Algebra: Patterns and algebra** • Substitute values into formulas to determine an unknown and re-arrange formulas to solve for a particular term (VCMNA333).

Table 2. Mathematics tasks for developing thinking about taxation and superannuation.

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Developing proportional reasoning through tax and super tasks

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Year 7 - Is paying tax good or bad?

Curriculum connections

Number and Algebra: Real numbers

- Find percentages of quantities and express one quantity as a percentage of another, with and without digital technologies. (VCMNA248).
- Recognise and solve problems involving simple ratios. (VCMNA249).

Mathematical focus

Percentage change problems describe the change between an initial value (*I*) and a final value final value (*F*). So, *F* > *I* for 'positive' changes such as adding GST to a price, earning interest with a bank account, or the new height of a plant after growth.

F < *I* for 'negative' changes such as a discounted sales price or the loan value after a repayment which covers the interest due and some of the initial capital. Students can solve percentage change problems given two out of three of the three quantities. For example: (1) Calculate F given I and % change, (2) Calculate I given F and % change, and (3) calculate % change given I and F.

Example using 10% GST:

$$\text{Recommended Retail Price} = \text{unit price} + \text{GST}$$

$$F\ (using\ percentages) = 100\%\ of\ I + 10\%\ of\ I = 110\%\ of\ I$$

$$F\ (in\ decimals) = 1.1 \times I$$

Key language: Introduce or revise such terms as *goods and services tax (GST)*, *GST inclusive price*, *price excludes GST*, *total price*, and *amount payable*.

Learning task

The GST is a tax of 10% applied to the sale of most goods and services, and contributes almost a quarter of state revenues. Calculations are used to add and subtract GST. For example, to figure out how much GST is included in a GST inclusive price, divide the amount payable by 11. To work

out the value of goods or services before GST, divide the amount payable by 1.1. Consider the following questions:

1. Su would like a bottle of perfume that costs $89.95 (including GST). How much GST is collected as part of this sale?
2. Su's friend is travelling overseas and has offered to purchase the same bottle of perfume for Su duty or tax free. How much might Su expect to pay?
3. Think about this situation from both the government's and Su's perspectives. Should Su feel a responsibility to pay GST? Explain your thinking.

Enabling prompts:

- What would be the final recommended retail price (RRP) if the price excluding GST is $80.
- How much GST is collected if the GST inclusive price is $90?
- GST is known as a flat tax because everyone pays the same rate (10%) no matter how much they earn. Do you think this is fair? Are there some items which should not have GST added? Explain your thinking.

Extending prompts:

- Derive a formula to explain the linkage between the initial price (excluding GST), GST of 10%, and the final price (inclusive of GST). What would be the formula if GST is 17%?
- Other countries collect GST, which is sometimes called a value added charge (VAT). Find out what rates other countries use. Modify your formula above to apply to any rate of, say, *r*%.
- Derive a formula to show the link between the full RRP and the discounted sales price of an item with a sales discount of 25%.
- What would be the general formula for an initial price (*I*), final price (*F*), and percentage change (*r*) where r can be positive or negative? How would you explain this to another student?

Important pedagogical considerations

- Invite students to share what they know and understand about tax. They may be working and therefore paying tax.
- Make sure students record their mathematical working and their explanations.
- Ask students to convince you that their solutions are mathematically sound.
- Remind students to check the appropriateness of their solution against the problem, as well as any potential impact on individuals, families, communities and society.

Student handout

If you would like to use a student handout for this task, please print out the next page.

Year 7 - Is paying tax good or bad?

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Developing proportional reasoning through tax and super tasks

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Year 8 - Can a sugar tax lower rates of obesity?

Curriculum connections

Statistics and Probability: Data representation and interpretation

- Identify everyday questions and issues involving at least one numerical and at least one categorical variable, and collect data directly from secondary sources (VCMSP324).
- Compare data displays using mean, median and range to describe and interpret numerical data sets in terms of location (centre) and spread (VCMSP326).

Mathematical focus

Data representation and interpretation are important skills in our information-rich technological world. Data can be shared in tables or charts (e.g., bar charts, pie charts, line graphs, box and whisker plots, and scatterplots). It is important to read the title of a graph and the name on each axis to ensure accurate interpretation, but further background might also be needed for a meaningful interpretation. For example, in a percentage change graph, we can only determine the size of the change and there is no detail about the size of the initial value nor final value. So, a large change in a relatively small market might not be significant in terms of economic impact or behavioural change.

Here are two methods to calculate the percentage change:

$$\%\ change = \frac{New\ Value - Old\ Value}{Old\ Value} \times 100 = \frac{New\ Value}{Old\ Value} \times 100 - 100$$

Key language: Introduce or revise such terms as *tax*, *excise*, *rate*, *consumption*, *sales volume*, *categories*, *estimate*, and *prediction*.

Learning task

Taxes can be used to increase the cost of particular products so as to discourage people from buying them. In Australia, such excises apply to the manufacture of cigarettes and alcohol.

Since around 28% of Australians are overweight or obese, the Australian Medical Association has suggested that the Federal Government should apply a "sugar tax" to sugar-sweetened beverages such as soft drinks. A sugar tax would increase the cost of these drinks with a view to reducing their consumption and rates of obesity.

A sugar tax was introduced in the UK in 2018. Figure 1 shows the estimated impact on sales volumes of various categories of drinks (Oxford Economics, 2016).

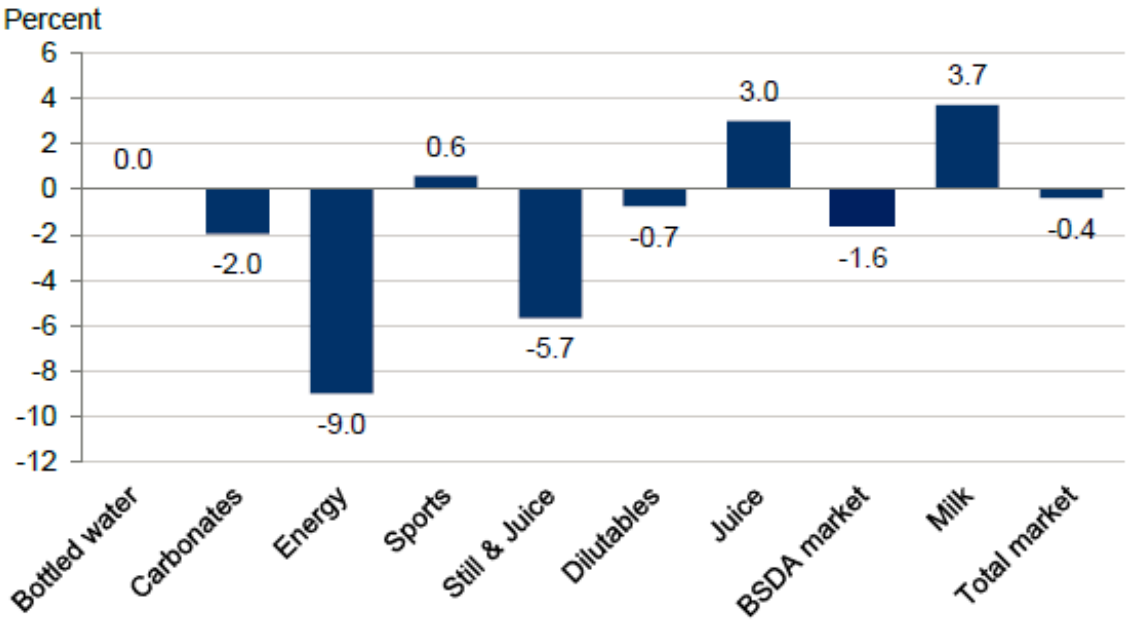

Figure 1. Estimated impact on sales volumes by drinks category (Oxford Economics, 2016).

A recent survey of UK shoppers found that 62% say they have not changed the amount of sugary drinks they purchase in any way since the introduction of the sugar tax (Ceylan, 2018). However, manufacturers have been researching and developing products that contain significantly less sugar, meaning most soft drinks sold now actually fall below the sugar tax threshold (Pym, 2018).

1. Refer to the data above to write three simple statements of fact. For example, what was predicted might happen and what has actually happened in the UK?
2. Do you think a sugar tax could work to lower obesity rates in Australia? Why / why not?
3. If an Australian political party proposed a sugar tax as part of their election campaign, would you vote for them? Why / why not?

Enabling prompts:

- Which products had the biggest decrease in sales volume?
- Which products had the biggest increase in sales volume?
- Which products do you think are less healthy?
- Which products do you think a government could justifiably tax?
- Which products do you think a consumer would still drink even if the price went up?

Extending prompts:

- Gather data on current and historical drinks sales volume and sales value in Australia and which, if any, of these drinks are taxed. How could you communicate this data to others?
- Gather price data for an example of each type of drink category. What would be a meaningful way to compare the prices? Collect data from classmates to determine what magnitude of price increase would deter them from purchasing the drink.

Important pedagogical considerations

- Invite students to share what they know and understand about tax. They may be working and therefore paying tax.
- Make sure students record their mathematical working and their explanations.
- Ask students to convince you that their solutions are mathematically sound.
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Student handout

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Year 8 - Can a sugar tax lower rates of obesity?

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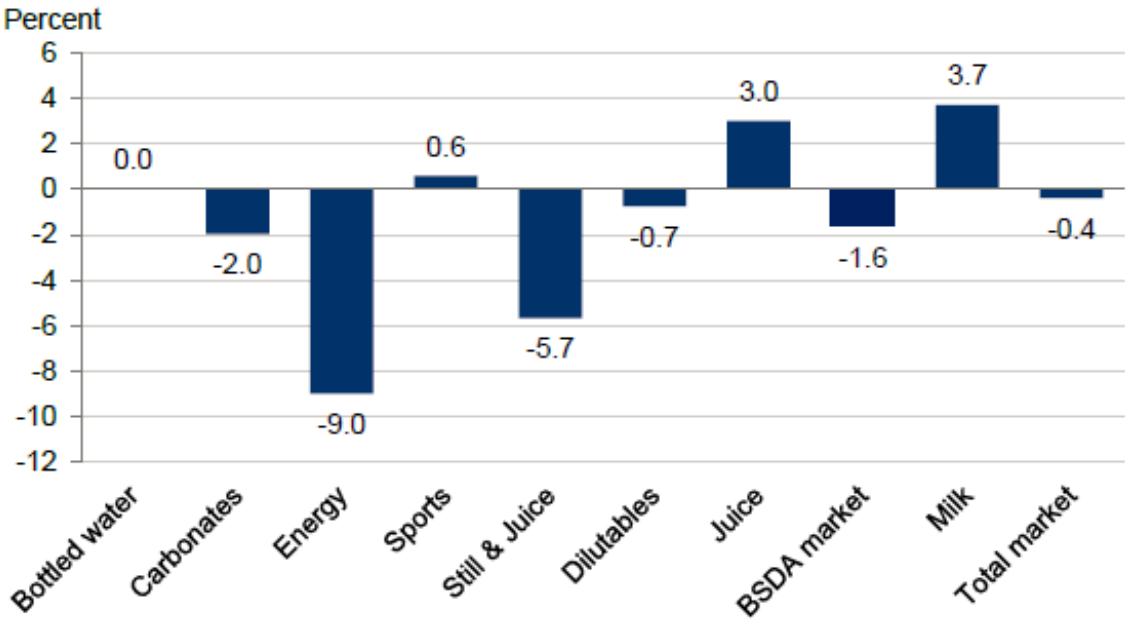

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Year 9 - How does career interruption impact taxation paid and superannuation saved?

Curriculum connections

Number and Algebra: Money and financial mathematics

- Solve problems involving simple interest (VCMNA304).

Number and Algebra: Patterns and algebra

- Apply set structures to solve real-world problems (VCMNA307).

Mathematical focus

There are several mathematical foci in this task: data collection, analysis, representation, interpretation, and scenario modelling. These are important tools for critical thinking and decision making. The act of collecting and collating data provides an opportunity for discussion of the quality of data and the impact of outliers. Statistical analysis includes the calculation of measures of central tendency (mean, median, mode) and measures of dispersion (range, interquartile range, variance/standard deviation), and determining how these measures help us understand the data.

While the learning task might be accessed and solved simply using averages multiplied by time, there is ample opportunity to challenge students to take a deeper, more precise approach via the extending prompts. Modelling of taxation and superannuation over time involves calculations using known quantities (e.g., number of working years, tax rates) and assumptions (e.g., average gross and taxable income). Justification of assumptions is important for their credibility (e.g., source of average income data, using mean versus median income). Decisions need to be made about the desired degree of accuracy, from a simple 'no changes from initial conditions' calculation to one involving changes in variables (e.g., income growth rate) and the time value of money (e.g., present value of future amounts due to impact of inflation over time). For example, calculation of a superannuation balance involves both the annual contribution (e.g, 9.5% of gross income) and the compound interest on previous contributions (which requires assumptions about the annual return on investment), as well as taxation on superannuation contributions and gains. Decisions also need to be made on the appropriate ways to communicate results so as to fairly represent the data and calculations.

Key language: Introduce or revise such terms as *taxation*, *superannuation*, *career interruption*, *parental leave*, *retirement*, *interest*, and *average*.

Useful information:
The average Australian weekly income for full-time workers is $1634 (gross / before tax).

The progressive tax scale for Australian residents in 2020 is as follows:

Taxable income	Tax on this income
0 – $18,200	Nil
$18,201 – $37,000	19c for each $1 over $18,200
$37,001 – $90,000	$3,572 plus 32.5c for each $1 over $37,000
$90,001 – $180,000	$20,797 plus 37c for each $1 over $90,000
$180,001 and over	$54,097 plus 45c for each $1 over $180,000

The Superannuation Guarantee Contribution (SGC) means employers must contribute 9.5% of employees' gross income to their nominated superannuation account.

Learning task

Each student is asked to interview two adults over the age of 35 (one male and one female). Interview questions might include:

- How old were you when you started working full-time?
- Has your career been interrupted by periods where you were unable to work, or worked part-time? If so, for how long?
- What caused you to take a lengthy period of time away from work (i.e., becoming a parent and caring for young children, study, travel, illness, caring for a parent)?
- At what age would you like to retire?

The class will use a spreadsheet to compile all data collected (hopefully 50+ responses). Then, students will work in small groups to analyse, interpret, and present findings. Questions to be explored might include, but are not limited to:

- What is the average number of years people plan to work?
- What then, is the average amount of taxation paid and superannuation saved over the course of one's working life?
- What is the average length of time that a career is interrupted?
- What is the most common reason given for career interruption?
- Can you calculate the average impact (in dollars) of career interruption on taxation paid and superannuation saved?

Students should prepare charts and graphs that show overall results and compare results for males and females.

Enabling prompts:

- What questions could you explore using this data?
- What is the minimum and maximum number of years that people plan to work? Compare the values overall for men and for women.
- What is the average (mean) number of working years overall? For men? For women?
- What is the median number of working years overall? For men? For women?
- What is the modal number of working years overall? For men? For women?
- Where could you find information about the average annual income in Australia?
- How much income tax would be paid by someone on the average income in Australia?
- How much employer superannuation contributions would be saved over the average working life?

Extending prompts:

- What questions could you explore using this data?
- Create a spreadsheet to more accurately examine the impact of career interruption on taxation paid and superannuation saved.
- Create a formula that calculates the average lifetime amount of taxation paid and superannuation saved assuming income increases annually at 1%, 3%, or 5% from the previous working year.
- Create a formula that calculates the average lifetime amount of taxation paid and superannuation saved in today's dollars assuming long term inflation of 2%.

Important pedagogical considerations

- Invite students to share what they know and understand about tax and super. They may be working and therefore paying tax and receiving super contributions.
- Make sure students record their mathematical working and their explanations.
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- Remind students to check the appropriateness of their solution against the problem, as well as any potential impact on individuals, families, communities and society.

Student handout

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Year 9 - How does career interruption impact taxation paid and superannuation saved?

Data collection

Interview two adults over the age of 35 (one male and one female). Interview questions might include:

- How old were you when you started working full-time?
- Has your career been interrupted by periods where you were unable to work, or worked part-time? If so, for how long?
- What caused you to take a lengthy period of time away from work (i.e., becoming a parent and caring for young children, study, travel, illness, caring for a parent)?
- At what age would you like to retire?

The class will use a spreadsheet to compile all data collected (hopefully 50+ responses).

Data analysis

Work in small groups to analyse, interpret, and present findings. Questions to be explored might include, but are not limited to:

- What is the average number of years people plan to work?
- What then, is the average amount of taxation paid and superannuation saved over the course of one's working life?
- What is the average length of time that a career is interrupted?
- What is the most common reason given for career interruption?
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You should prepare charts and graphs that show overall results and compare results for males and females.

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Year 10 - How much is enough superannuation?

Curriculum connections

Number and Algebra: Money and financial mathematics

- Connect the compound interest formula to repeated applications of simple interest using appropriate digital technologies (VCMNA328).

Number and Algebra: Patterns and algebra

- Substitute values into formulas to determine an unknown and re-arrange formulas to solve for a particular term (VCMNA333).

Mathematical focus

The underlying rationale for superannuation is "saving" money each year and earning a return on investment on that money over time. In the first year after money is contributed to superannuation, the return generated mimics 'simple' interest:

$$Simple\ Interest = Principal\ \times Interest\ Rate\ \times\ Time$$

However, in each subsequent year, a return is also generated on the returns on previous contributions, so it mimics annual 'compound' interest:

$$Compound\ Interest = Principal \times (1 + Interest\ Rate)^{Time} -\ Principal$$

When interest is compounded *n* times per year, the formula becomes:

$$Compound\ Interest = Principal \times \left(1 + \frac{Interest\ Rate}{n}\right)^{n \times Time} -\ Principal$$

In all these cases, the new principal is the original principal value plus interest earned. However, in the case of superannuation, new contributions are made each year based on income earned, so investment returns are generated on the original contribution, the new contributions, and the returns on previous contributions. Students can use a spreadsheet to model and compare simple and compound interest on an initial investment amount versus the returns earned from regular superannuation contributions over time.

While working, superannuation accumulates. When people retire, their superannuation becomes available as an untaxed source of regular income (self-funded pension payment). Due to inflation, living costs increase over time, which means…

Key language: Introduce or revise such terms as *average weekly income*, *gross income*, *net income*, *superannuation*, *Superannuation Guarantee Contribution (SGC)*, *voluntary contribution*, '*topping up' super*, *percent*, and *inflation*.

Learning task

The average Australian weekly income in 2020 for full-time workers is $1634 (gross, i.e., before tax). The Superannuation Guarantee Contribution (SGC) means employers must contribute 9.5% of employees' gross income to their nominated superannuation account. Consider the following questions:

1. Assuming an average income and average superannuation return of 8% annually over 50 years of work, how much superannuation will Ying retire with?
2. It seems as though Ying will have plenty of money, but will she have enough to meet her living costs? Explain your thinking.
3. What would be the impact on Ying's retirement balance if she 'topped up' her super with annual voluntary contributions of $1000 every year she worked?

Enabling prompts:

How much money would Ying have if we assume 50 years employment, average income and zero returns on superannuation investment?

Extending prompts:

- Model the superannuation contributions and returns using a spreadsheet. What information was provided? What assumptions did you make? How much money did Ying have after 50 years to fund her retirement?
- Why might median income be a better basis than average income for thinking about a typical person's superannuation after 50 years of working?
- Create a formula that calculates the impact of a negative investment return. How might the timing of such an event impact retirement plans?
- Model how the cost of living changes (food, housing, healthcare) over a person's life, based on key life stages (before kids, raising and educating kids, divorce, retirement)?

Important pedagogical considerations

- Invite students to share what they know and understand about tax and super. They may be working and therefore paying tax and receiving super contributions.
- Make sure students record their mathematical working and their explanations.

- Ask students to convince you that their solutions are mathematically sound.
- Remind students to check the appropriateness of their solution against the problem, as well as any potential impact on individuals, families, communities and society.

Student handout

If you would like to use a student handout for this task, please print out the next page.

Year 10 - How much is enough superannuation?

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