

## Working in insurance: Teacher notes

### Overview

In this lesson students develop a spreadsheet model of the value of an insurance fund as it grows over a 20-year period with compound interest. They develop the model to consider how the amount in the fund varies because of a) the amount invested and b) the interest rate and they go on to discuss the assumptions underpinning their model. Towards the end of the lesson they are introduced to the work for the next lesson: to develop their model to include payouts for those who die and how they need to vary this to take account of a) the number of investors, b) the amount invested by each person c) amounts paid out of the fund, which in turn depends on d) the number of deaths and e) the amount paid to each of the beneficiaries of those who died.

### Aims and objectives

To consider some of the important factors associated with investments and model how an investment fund might grow over time.

### Lesson outline

Students will probably be aware that investing money in a savings scheme attracts interest so that after one year it is worth more than the amount invested. They should also be aware of compounding –that as each year passes, if interest rates stay the same throughout and the money is left in the bank, the amount in the account increases by an increasing amount.

It is important that students understand that the reason why the investment increases by an increasing amount each year is because the interest is earned not only on the invested amount but also the interest earned to-date.

Following a brief introduction to the purpose of the lesson discuss with the class how the fund will grow if the amount in the fund is subject to simple and compound interest. Use questions such as:

*What happens to your money if you invest a lump sum in a bank account for a long time? What would it be worth after one year? Five years? Twenty years? What would happen to the amount by which your savings increased each year if you never took any money out of the account?*

**Tell the students that you want them to develop their model by allowing someone to enter any amount for the initial investment and any interest rate as input variables. They should be able to type these in and the spreadsheet should adjust automatically.**

A worked spreadsheet (Stage1.xls) is available to show the class. Whether or not you show it to the class at this stage will depend on your class and their experience with spreadsheets.

*Note that throughout this unit examples of the sorts of spreadsheets the students might produce are provided. The convention adopted is that the labels and quantities of amount that the user should be able to vary (e.g. interest rate) are coloured yellow.*

The spreadsheet includes a graph, which is not necessary but gives a clear visualisation of how the investment grows over time. You and your class might like to look at how the shape of the graph changes with different interest rates. You may like to discuss how the compounding gives rise to a curve and its gradient gets steeper as time increases. So that the effect of different interest rates can be seen the scaling of vertical axis of the graph has been fixed.

You might need to remind students that if they want a variable to remain fixed when the formula is replicated, they should use the \$ sign. (e.g. if the interest rate is in cell C2 their formula should use \$C\$2.)



**Ask the students to identify any assumptions that they made in developing their model, and to consider how realistic the model is.**

There are three main assumptions that underpin the modeling situation presented in this lesson:

- The interest is paid once a year
- The interest remains constant throughout the investment period
- No money is deposited into, or withdrawn from, the fund during the investment period.

The model encompasses all the assumptions that have been made and how these have been handled mathematically as well as the spreadsheet itself. The spreadsheet plays an important role in calculating and it embodies the assumptions that have been made, but the model is more than the spreadsheet.

In considering how realistic the model is, you could use questions such as the following,

*How often is interest likely to be paid? Is the interest likely to vary over a 20-year period? What is a realistic value for the interest rate? Under what circumstances might someone invest a lump sum and leave it invested for twenty years?*

Also discuss the real world situation that is being modeled. Lead the discussion towards how funds are sometimes set up by insurance companies, for example, for pension schemes. Often these are based on adding regular monthly or yearly payments – a different situation that some quick students may like to model.

Explore ideas of what constitutes ‘the model’ and the role of the spreadsheet.