

The legacy

Modelling and optimisation

Prerequisite knowledge

- Percentages and interest
- Formulae in a spreadsheet

Why do this unit?

The aim is to investigate the strengths and limitations of different models of investment. The lesson notes are based on pupils exploring, comparing and evaluating the models that are given.

Time

Two lessons

Resources

CD-ROM: spreadsheet, problem sheet, resource sheets 1–5
NRICH website (optional):
www.nrich.maths.org, November 2007, 'The legacy'

The legacy

Problem sheet

A school has been left £1 000 000 in the will of an ex-pupil. The constraints on how the money should be invested and used are:

- The money should have a lifetime of approximately 50 years.
- The school must benefit in some way (spend part of the investment) every year.

You have been asked to evaluate models of investment and expenditure based on any balance being invested at different rates of interest and possibly considering different inflation rates.

What model would you choose to ensure the best return for the school over a period of 50 years (or longer if you wish)?

Maths Trails: Excel at Problem Solving | Problem and resource sheets © Cambridge University Press 2008

Introducing the unit

Turn to the problem sheet.

After spending some time making sense of the problem and what we mean by a model, discuss ideas for making good use of a legacy.

- What things should the money be spent on? [large or small projects; long-term or short-term impacts]
- Why would the ex-pupil want the money to have a long-term impact? [so that they can see what is happening in the school over a long period; they do not want the money spent on a one-off thing ...]
- What is the importance of inflation in any model we try? [money is worth less as time goes on]
- Why would you invest the money? [to make more money; to make the money last]

Main part of the unit

Note that models on the red tabs on the spreadsheet are identical to those on the corresponding green tabs but use absolute referencing to enable you to quickly change values if needed during the discussions. Alternatively, any of the sheets may be used by pupils as they investigate.

Use the sheet 'Double'.

- What do the formulae in each cell do?
- How long do you think it would take for the money to double? [18 years; extend the spreadsheet to check]

Discuss doubling for different interest rates and amend the spreadsheet to test out hypotheses.

- Would an interest rate of 8% mean the money would double in half the time? Why do you think this?

Spend plenty of time on the examples 'Model one' and 'Inflation', examining how they have been constructed. Look at:

- how to change the interest rate;
- how (on the 'Inflation' sheet) the formula can be adapted to change the annual expenditure to take account of inflation;
- why no interest has been added at the end of the first year. [Because it has been added at the start of the second year and is based on the balance assuming that the expenditure is made at the beginning of any year the interest is paid at the end – though the model could have been constructed differently.]

Look at each of the models (A to E) on the spreadsheet. Discuss what each model is aiming to do and how they differ.

- What variables can you change in each sheet?

Ask pupils to work in pairs and investigate one of the five models. As some of the models are more complex than others you may wish to allocate them to particular pairs.

Hand out the resource sheets for each model and explain that the main aim is to present a recommendation to the school on the merits, and weaknesses, of that model. As a whole class you will decide which one to recommend to the headteacher and governors. Explain that some ideas for exploration are given on each resource sheet. Pupils should prepare to include in a presentation to the class:

- assumptions they made (e.g. inflation rates and interest rates);
- what the particular strengths and weaknesses of their model are.

They are to act like consultants and make a recommendation for or against their model with a sound argument.

Towards the end of the unit pairs of pupils working on the same model combine to decide on a joint presentation of their findings.

Plenary

Each group presents their recommendations to the whole class, who then agree on a recommendation to make to the headteacher.

Solution notes

There is no right answer to this problem. A group of pupils may put a very strong case for what might appear to be a weaker model. This would be an ideal opportunity to discuss

the implications this has for the way we respond to advertising and marketing in our everyday lives.