

## Interactive mathematics lessons for KS3 and KS4 using Excel An INSET Pack

### Multiplying out and factorising quadratic expressions at KS4

#### Lesson activities

This section outlines a number of activities for direct use in relation to the KS4 Higher Programme of Study.

#### Using the Excel files

The Excel files contain macros. Consequently, in order to use them you need to set the security level in your Excel to 'Medium' or 'Low', as follows:

Open Excel - Click on:

- *Tools* on the menu bar at the top of the screen
- *Options*
- The *Security* tab
- *Macros security* towards the bottom of the box
- Either 'Medium' or 'Low' to reset the security level
- 'OK' twice

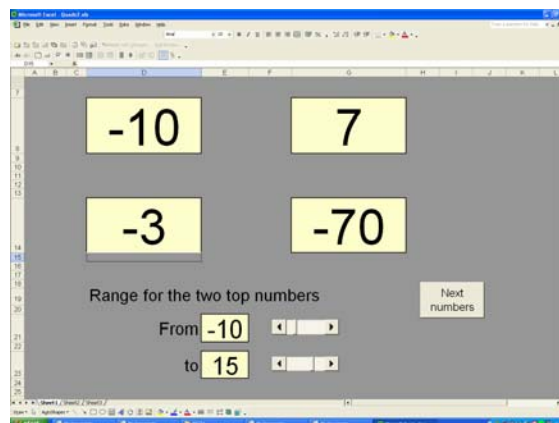
Doing this only affects the security levels within Excel.

#### Description of the *Quads* programs

##### *Quads1*

Integers between 1 and 10 are randomly generated when you click on 'Next numbers' and their sum and product are displayed. Any of the four numbers on the screen can be hidden or revealed.

##### *Quads2*



This is like *Quads1*, with the additional facility that there is a scroll bar to control the range of input numbers: the user can select the range for the integers displayed at the top of the screen within the overall range of -20 to 30.

# Quads3

$(x + 6)(x + 4) = x^2 + 10x + 24$

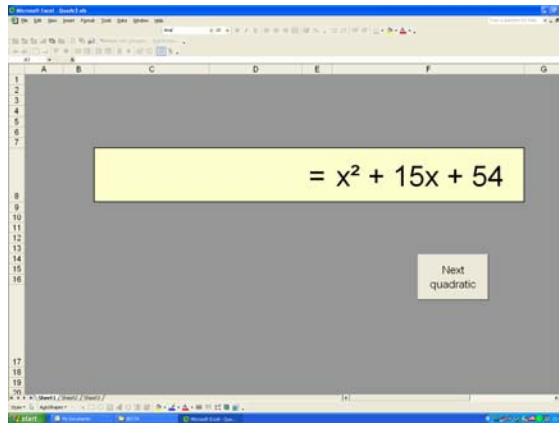
Next quadratic

$(x + 5)(x + 8) =$

Next quadratic

$(x + 2) = x^2 + 9x + 14$

Next quadratic



Every time you click on 'Next quadratic' a new example is generated. Each part of the expression can be hidden and then revealed. All the signs are positive and the coefficient of  $x$  in both brackets is always 1.

#### *Quads4*

This is the same as *Quads3*, except that the signs in the brackets can be positive or negative.

#### *Quads5*

This is the same as *Quads4*, except that the coefficients of  $x$  are not always 1.

### **KS4 Higher National Curriculum links**

- Expand the product of two linear expressions (Ma2, 5b)
- Factorise quadratic expressions (Ma2, 5b)

### **Whole-class use**

These files are designed for the teacher to use with a whole class. The files are easy to use with an interactive whiteboard and can also be run from a keyboard using a projected image. They are not suitable for individual pupil use, because pupils can reveal the 'answer' at any stage. Hence, to be effective with the whole class, the teacher needs to plan carefully what to hide and when to reveal it.

### **Working with *Quads3*, *Quads4* and *Quads5* to find the product of two linear expressions**

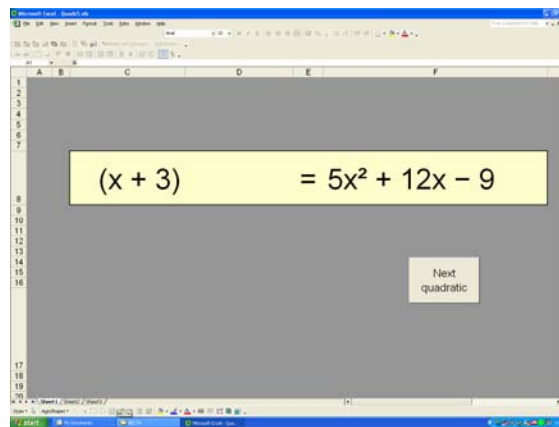
Use whichever program you think is appropriate for the class you are working with. Display a number of examples with nothing hidden and ask pupils to write them down. Can they suggest how to work out the product? If you are working with *Quads3* or *Quads4* pupils may suggest that the coefficient of  $x$  in the expression on the right-hand side is always the sum of the numbers in the brackets and the constant term is the product. This 'general rule' no longer applies when examples from *Quads5* are considered.

## Working with *Quads2* as an introduction to factorising

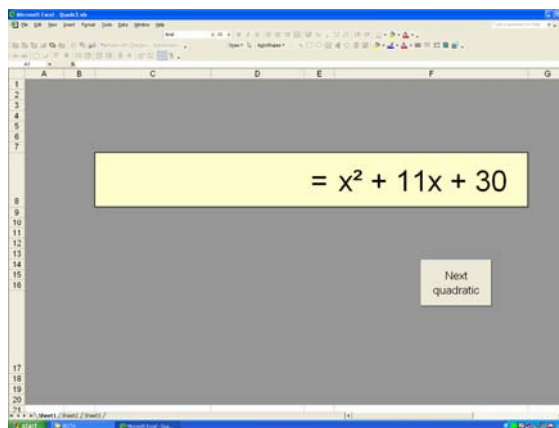
*Quads2* can be set up to operate like *Quads1*, by setting the range of numbers to be 1 to 10. The key to being able to factorise a quadratic expression such as  $x^2 + bx + c$  is to find a pair of integers whose sum is  $b$  and whose product is  $c$ . Hence, *Quads2* provides an appropriate activity to practise this skill in preparation for factorising quadratics. Hide the numbers in the top two boxes and then click on 'Next numbers'. The level of difficulty can be adjusted in response to pupil feedback. If you are preparing pupils to factorise expressions such as those in *Quads4* you will need to set the range to -10 to 10.

## Working with *Quads3*, *Quads4* and *Quads5* to factorise quadratic expressions

The assumption usually made is that expressions of the type  $x^2 + 7x + 12$  (i.e. those of the type contained in *Quads3*) are the easiest to factorise. However, in the *Quads* programs you can hide one of the linear factors and reveal the other; you can then ask pupils to find the hidden factor.



Using *Quads5* and working on completing expressions like this, which introduce all the complexities at once, may be the most effective for some learners. Others may benefit from starting by working with this image from *Quads3*:



having first worked on the *Quads2* activity described above.

Teaching a technique for factorising is not easy, because one needs to 'reverse' whatever procedure one has in one's head for multiplying out two expressions. So

spending time on discussing how to complete 'incomplete' expressions is worthwhile as it enables pupils to develop their own procedures.

Once pupils have found a technique they understand for finding both factors it is easy using the files to generate many examples to provide consolidation and practice.

### **Working with *Quads3*, *Quads4* and *Quads5* on multiplying out and factorising simultaneously**

The files give you the option of seeing multiplying out two linear expressions and factorising the resulting quadratic expression as a single concept. By hiding different parts of the expression in turn and inviting pupils to complete it they may gain a better understanding of the whole process.

For some pupils this approach will be most effective if you start with *Quads3* and then progress to *Quads4* and then to *Quads5* as the techniques are mastered. As before, you need to spend time on allowing pupils to develop procedures for multiplying out and factorising which work for them.

## **Pedagogical issues**

Using *Quads* programs with the whole class is likely to enhance mathematical learning because:

- there is a shared image, which encourages whole-class discussion
- the attention of the class is on the IWB, rather than on the teacher and so learning becomes a collaborative process
- the program can be used in lots of different ways in response to pupil feedback
- different parts of the image can be hidden in turn, thus enabling learners to focus on a particular aspect while at the same time continuing to see the situation as a whole
- the program can be used to help pupils develop their own procedures for algebraic manipulation
- you can pose lots of different questions easily
- you get instant feedback
- the pace of the lesson is increased