Using Excel to Individualise Basic Mathematics Assignments

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Abstract

This paper sets out a method for creating and marking individualised mathematics assessments for students based on their ID numbers. It therefore provides a means for setting assessed coursework questions that give students the incentive to put in the practice needed to master mathematical techniques without the risk of collusion between students. A marking grid can then be constructed using only basic Excel skills. The method is explained here in the context of basic mathematical techniques applied to economics, but it can also be applied to other academic disciplines that involve numerical problems.

Introduction and pedagogic rationale

In any academic discipline where mathematics is applied to numerical problems, students need to practise examples to develop the relevant mathematical skills. Although students with relatively weak mathematical ability need to practise more than others, they are often reluctant to put the effort into doing this unless their work is assessed. However, collusion is likely if students are all set the same questions for coursework.

On-line tests with randomised numerical examples can partly address this problem, but they do not allow students to get individual feedback on errors made, or allow questions on interpretation of results. If only in-class tests or examinations are used then students do not get the opportunity to develop their mathematical skills by referring to lecture notes, textbooks and other learning resources to help them. Also, relevant and realistic applied mathematics problems may be rather too long to be answered in a time constrained examination, or may be best answered by students constructing their own spreadsheets.

This paper sets out a method for addressing all these issues by using individualised coursework questions for each student based on their ID number, with an easily readable set of answers for marking generated via Excel. Manual marking is then relatively quick and allows for specific feedback on any errors students may make.

This method also enables tutors to set questions that:

- ask students to interpret results
- are more time consuming than those used in typical examinations or online tests
- require students to construct their own spreadsheets.

The heterogeneity of students' aptitudes, learning styles, previous knowledge and motivation, particularly with respect to quantitative subjects, can be addressed by providing the opportunity for learner autonomy. Because they have mathematics questions that they can work on at home, the approach developed here affords a degree of learner autonomy as students can work on these at their own pace, drawing on the teaching materials and other learning resources that are available to them.

In quantitative disciplines, such as mathematics for economists, allowing students to use relevant computer based programmes to tackle more realistic, relevant and demanding problems is also a valid pedagogic rationale, supported by various articles in CHEER. However, while computer based teaching has its benefits, it has its shortcomings, particularly with regard to feedback and assessment and cannot be used in isolation. As Perkins (1993) found, not all students will take up the opportunities computer based learning resources may offer them, unless there is sufficient incentive. Also, the process of dialogue that is necessary between teacher and student to develop the latter's critical and evaluative thinking can be difficult to incorporate in automated computer based teaching packages, as Laurillard (1993) points out, unless there is a facility for manual tutor feedback to individual students.

In this mathematics for economics assessment method the student incentive issue is addressed by making the assessment summative, but with individualised questions to minimise collusion and plagiarism. Manual feedback can be addressed at the specific areas where students may

need help and direction and can be adapted as necessary in the process of dialogue between teacher and student.

These features also tie in the criteria that Race (2005) believes assessments should meet:

- Authenticity in both the sense that the individuals cannot copy others' work and in the sense that more realistic questions can be set.

- Manageable, as the marking grid allows for relatively quick marking of numeric answers.

- Diversity of assessment, achieved by the way this method can be used in conjunction with other more conventional assessment methods, e.g. by asking the student to explain, comment on and interpret results as well as producing quantitative answers.

Background

Although the idea of creating questions that are individual to each student is not new, this paper differs from other approaches, such as Simonite, Ells and Turner (1998), Hunt (2005) and Hunt (2007), both in approach and in the level of computing skills necessary for a tutor to set up questions. Instead of data sets for each students being generated by a relatively sophisticated computer based system, each student simply creates their own questions by referring to the digits that make up their student ID number. The set of answers for each student can then be produced using relatively straightforward Excel spreadsheets.

This method has been used for the assessment of first year undergraduate mathematical techniques for economics and accountancy students at Coventry for the past two academic years, with successful results, and thus the examples in this paper are applied to these subject areas. However, this method can easily be adapted for applications in other subject areas, such as engineering, or simply for the teaching of mathematics itself.

Following a revision of all undergraduate degrees at Coventry University in 2006, all first year Economics and Accountancy students are now taught Mathematical Techniques in the same module. The majority do not have A-level Mathematics, and most have not had much practice using mathematics since doing their GSCE two years before coming to university.

To meet the challenges of this change, the methods of teaching and assessing students were radically altered. The basic philosophy adopted was to get all students practising mathematical techniques with numerical examples. This approach was used in lecturers, the course text book, Rosser (2003), and formative practice questions, as well as the summatively assessed questions using the individualised assessment method set out in this paper.

It should be noted that individualised coursework assessment for basic mathematics for economics is used at Coventry in conjunction with other assessment methods, including in-class tests and a time constrained end of year examination.

Overview of method used

All educational institutions give each student a unique ID number when they enrol, and tutors are normally able to obtain electronic class lists of students' ID numbers. The essential feature of this individualised assessment method entails setting up mathematical questions which contain letters that correspond to specific digits in these student ID numbers. For example, at Coventry University all students have a seven-digit ID number and so at the start of a typical assignment the instruction shown below appears:

The reason why the letter sequence starts at B rather than A is explained below, when the Excel answer grid is developed.

Note also that this example contains some numbers alongside the letters corresponding to digits in the Student ID number. This is to ensure that answers fall within a specified range, such as a positive output level, as explained more fully later on.

Separating a number into its digits

There are several ways to break down a number into the digits that it is composed of. A method based on a simple set of Excel formulae is set out below. It should, however, be noted that this only has to be done once, as this set of formulae can then be pasted into any further spreadsheets used for different assignments.

The method essentially involves the following steps (using the seven-digit ID number 1234567 as an example):

i   Dividing by 1,000,000 (which gives1.234567) and rounding down. (This example rounds to 1.)

ii Dividing by 100,000 and rounding down and subtracting the first digit obtained in step (i) after multiplying it by 10. (Thus 1234567 divided by 100,000 and rounded down gives 12 , less 1 x 10 = 2.)

iii Dividing by 10,000 and rounding down and subtracting the first digit obtained in step (i) after multiplying by 100 and then subtracting the second digit obtained in step (ii) multiplied by 10. (Thus 1234567 divided by 10,000 and rounded down gives 123, less [(1 x 100) + (2 x 10)] = 3.)

and so on.

INSTRUCTIONS - The values you need to use to answer the questions below will depend on your student ID number (SID) which is the number on the left on your university ID card.							
Write your SID in the boxes under the letters B to H in this grid: You should then write in values for each question corresponding to the letters above each digit in your SID.	B	C	D	E	F	G	H
For example if your SID was 1234567 then in question 1 below where the demand function is p = 8BC – 1Dq your demand function would be p = 812 – 13q							

	A	B	C	D	E	F	G	H
1								
2								
3								
4	SID	B	C	D	E	F	G	H
5	1234567	=ROUND (A5/1000000-0.5,0)	=ROUND (A5/100000-0.5,0)-B5*10	=ROUND (A5/10000-0.5,0)-B5*100-C5*10	=ROUND (A5/1000-0.5,0)-B5*1000-C5*100-D5*10	=ROUND (A5/100-0.5,0)-B5*10000-C5*1000-D5*100-E5*10	=ROUND (A5/10-0.5,0)-B5*100000-C5*10000-D5*1000-E5*100-F5*10	=ROUND (A5-0.5,0)-B5*1000000-C5*100000-D5*10000-E5*1000-F5*100-G5*10

Figure 1. Spreadsheet for splitting a number into its component digits

Although this method may seem rather cumbersome, it is relatively straightforward to build this set of calculations into an Excel spreadsheet, as in Figure 1 above. Note, though, that 0.5 has to be subtracted from the numbers obtained by dividing by 1,000,000, 100,000, etc., before using the Excel ROUND function, otherwise numbers ending in 0.5 or more will be rounded up instead of down.

Using the set of formulae shown in Figure 1 will give the values shown in Figure 2 in columns B to H. Once created, this section of the spreadsheet can then be reused for other assignments.

	A	B	C	D	E	F	G	H
1								
2								
3								
4	SID							
5	1234567	1	2	3	4	5	6	7

Figure 2. Section of spreadsheet

The reason why it is best to represent the first digit in a student's ID number by B rather than A now becomes more obvious, given that the student ID numbers are pasted into column A. As the formulae that will be set up to calculate specific answers will refer to the values in columns B to H it makes it a lot easier to have digits referred to by letters that correspond to these columns.

Dealing with 007

All students need to have acceptable values for variables and answers for their individualised problems. However, if we simply let specific digits in their ID numbers represent specified variables, such as interest rates, this can cause problems. For example, if student James Bond has the ID number 0000007, then if digits DE represent the interest rate in an investment problem, inputting an interest rate of 0.0% will probably not give this student a realistic problem to solve and may lead any calculations into a dead end.

To cope with this problem it is often best to set up problems with numbers that are a mixture of given digits, that will be the same for each student, and digits that will depend on students' ID numbers. For example, in an investment problem the interest rate could be specified as 5.DE%. This would mean student number 0000007 would use 5.00%, which is realistic, and other students would

also have interest rates within a close range but still different, and therefore leading to different answers.

Even if these precautions have been taken, it may still be possible for a particular student ID number to give an unrealistic answer, such as a negative output. However, it is very simple to test for this problem. The Excel formulae for a set of problems can just be copied down the worksheet page so that answers are computed for all student ID numbers. It is then easy to spot any anomalous answers and make any necessary adjustments to the question parameters

Question set up – Example 1

Consider the following simple supply and demand linear equation problem:

Find equilibrium P and Q in a competitive market given

the demand function P = $a - b$Q

and the supply function P = $c + d$Q

where numbers are specified for the parameters a, b, c and d.

In an individualised mathematics question this problem could be specified, for example, as:

Question 1
In a competitive market with the demand function P = *2CD - E.5Q and the supply function* P = *2F + 3.GQ , find equilibrium price* P *and quantity* Q.

The inclusion of the specified digits ensures that the demand and supply functions will yield answers in a reasonable range.

Although the final marking grid will just contain rows showing the answers corresponding to the student ID numbers in the first column, it is best to create a 'full workings' spreadsheet page showing the actual numbers that each student should be using and, where appropriate, some intermediate steps in the calculation. For incorrect answers, this will enable the tutor to check:

- If students started off with the wrong number (possibly because they copied off a friend).

- At what stage the answer started to go wrong.

For this supply and demand question we can do this as follows:

- In header row 2 put Q.1 in column I.

	A	B	C	D	E	F	G	H	I	J	K	L
1												
2									Q.1			
3									a	b	c	d
4	SID								**2CD**	**E.5**	**2F**	**3.G**
5	1234567	1	2	3	4	5	6	7	=200+C5*10+D5	=E5+0.5	=20+F5	=3+0.1*G5

Figure 3. *(Note that formulae for calculated digits in columns B to H are not shown, for clarity's sake)*

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1														
2									Q.1					
3									a	b	c	d		
4	SID								**2CD**	**E.5**	**2F**	**3.G**	Equil Q	Equil P
5	1234567	1	2	3	4	5	6	7	223	4.5	25	3.6	=(I5– K5)/(J5+L5)	=I5– J5*M5

Figure 4. *(Note that the formulae in columns B to L are not shown, for clarity's sake)*

- In header row 3 put usual algebraic notation terminology for parameters/variables in the question, in this case the parameters a, b, c and d in columns I to L. (This is helpful when devising formulae for answers.)

- In the header row 4 put the alphanumeric values that students are expected to use for the question, in this case 2CD, E.5, 2F and 3.G in columns I to L..

If an example student ID number is put in cell A5, and assuming the formulae given in Figure 1 have already been entered in cells B5 to H5, we can now enter formulae to create the numbers that each student will start their question with.

To create the number 2CD we just break it down into hundreds, tens and units. Thus

2CD = 200 + (Digit in Column C x10) + (Digit in Column D)

The Excel formula to calculate this is shown in cell I5 in Figure 3 above.

The other numbers in are created in the same fashion. Thus:

Number E.5 is created in cell J5 by adding 0.5 to the digit in column E.

Number 2F is created in cell K5 by adding 20 to the digit in column F.

Number 3.G is created in cell L5 by adding (0.1 x digit in column G) to the number 3.

Finally, to compute the answers to this problem we need to devise an Excel formula based on the algebraic solution.

In equilibrium, demand price equals supply price. Thus given $P = a - bQ$ and $P = c + dQ$

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1														
2									Q.1					
3									a	b	c	d		
4	SID								**2CD**	**E.5**	**2F**	**3.G**	Equil Q	Equil P
5	1234567	1	2	3	4	5	6	7	223	4.5	25	3.6	24.44	113.00
5	1235414	1	2	3	5	4	1	4	223	5.5	24	3.1	23.14	95.73
7	1235902	1	2	3	5	9	0	2	223	5.5	29	3	22.82	97.47
8	1238647	1	2	3	8	6	4	7	223	8.5	26	3.4	16.55	82.29
9	1240319	1	2	4	0	3	1	9	224	0.5	23	3.1	55.83	196.08
10	1241128	1	2	4	1	1	2	8	224	1.5	21	3.2	43.19	159.21

Figure 5. *(Note that the formulae in columns B to N are not shown, for clarity's sake)*

then $a - bQ = c + dQ$

$a - c = dQ + bQ$

$a - c = (d + b)Q$

and so in equilibrium $Q = \dfrac{a-c}{d+b}$

The Excel formulae shown in cell M5 in Figure 4 is then entered based on this algebraic formula to calculate equilibrium quantity.

Equilibrium price can then easily be found by inserting the already calculated value for equilibrium quantity into the demand function P = $a - bQ$ = 2CD – E.5Q as shown by the Excel formula in cell N5 in Figure 4.

The formulae in cells B5 to N5 can now be copied down the worksheet page so that answers are generated for whatever set of student ID numbers is pasted into column A, as illustrated for the example set of student ID numbers in Figure 5.

For marking purposes, it is easiest to create a simplified Marking Grid worksheet page just showing the answers rather than all the intermediate steps. However before explaining how to do this, another slightly more difficult question is worked through. This time the steps already explained in example 1 are not repeated.

Question set up – Example 2

Suppose you wish students to use basic calculus to find the output that maximises a Total Revenue function (TR) and then, given a simple quadratic Total Cost function (TC), to set up the firm's profit function and find the output that will maximise profit.

In algebraic format the functions can be specified as

TR = $aQ - bQ^2$

and TC = $c + dQ^2$

where Q is output and *a*, *b*, *c* and *d* are specific parameters.

To answer the first part of the question students would be expected to differentiate and set equal to zero, giving

$$\frac{\mathrm{d}TR}{\mathrm{d}Q} = a - 2bQ = 0$$

Thus total revenue maximising output is $Q = \dfrac{a}{2b}$

Students would also be expected to check the Second Order Conditions (SOC) for a maximum and show that if

$$\frac{\mathrm{d}^2 TR}{\mathrm{d}Q^2} = -2b < 0$$

for all b >0 the SOC for a maximum are met.

To solve the second part of the question, students would be expected to set up the profit function

Π = TR – TC = $aQ - bQ^2 - (c + dQ^2)$

Π = $aQ - bQ^2 - c - dQ^2$

and then differentiate this function and set equal to zero to find the profit maximising output. Thus

$$\frac{\mathrm{d}\pi}{\mathrm{d}Q} = a - 2bQ - 2dQ = 0$$

$$a = 2Q(b + d)$$

$$\frac{a}{2(b+d)} = Q$$

To check the second-order conditions for a maximum, students would be expected to derive the second-order derivative and show that if

$$\frac{\mathrm{d}^2 \pi}{\mathrm{d}Q^2} = -2b - 2d \ < 0$$

this satisfies the SOC, e.g. if b and d are both > 0.

This question can be set up in individualised format by the usual method of substituting letters representing digits from students' ID numbers into the parameters of the functions given.

For example, the question might be specified as:

Question 2

A monopoly sells its output in a market where Total Revenue TR = 5EFq – 1Gq² and has the Total Cost function TC = 2H + 0.8q²

a Find the output that will maximise TR.

b Set up the firm's profit function and then find the output that will maximise profit.

As in the previous question, there is a mix of numbers and letters to avoid the 007 problem, and the first digit of each parameter is a specified number to ensure that answers will fall within a reasonable range.

The formulae for breaking down a seven-digit student ID number into its individual digits have already been entered in columns B to H.

The next step is to create the individual students' numbers for this question. Given that columns I to N have been used to set up the answers to question 1, for question 2 we can do this on the same spreadsheet as follows:

	A	B	C	D	E	F	G	H	...	O	P	Q	R
1													
2										Q.2			
3										a	b	c	d
4	SID									**5EF**	**1G**	**2H**	**0.8**
5	1234567	1	2	3	4	5	6	7	...	=500+E5*10+F5	=10+G5	=20+H5	=R$4

Figure 6. *(Note that the formulae for the calculated digits in columns B to H are not shown, and columns I to N are hidden, for clarity's sake)*

- In header row 2 put Q.2 in column O

- In header row 3 put the usual algebraic notation terminology for parameters/variables in the question, in this case the parameters *a*, *b*, *c* and *d* in columns O to R. (This is helpful when devising formulae for answers.)

- In the header row 4 put the format of the individualised number that students are expected to use for the question. Thus 5EF, 1G, and 2H need to be entered in columns O to Q and the specified numerical value 0.8 in column R. (As long as there is sufficient variation elsewhere in a question, some parameters may simply be specified numbers.)

Figure 6 above shows the appropriate Excel formulae

Now that the actual numbers each student will use for this question have been calculated in cells O5 to R5, Excel formulae for the answers can be entered in cells S5 to V5 based on the algebraic formulae set out below, as shown in Figure 7.

Total revenue maximising output $Q = \dfrac{a}{2b}$

with SOC check $\dfrac{d^2 TR}{dQ^2} = -2b < 0$

Profit maximising output = $Q = \dfrac{a}{2(b+d)}$

with SOC check $\dfrac{d^2 \pi}{dQ^2} = -2b - 2d$

Lastly, for this profit maximising question it is worth setting up a column to calculate what the maximum profit actually is, to check if all students end up with a positive profit, given that a negative maximum profit might make the problem a bit unrealistic, as the firm may then decide to cease operations.

Thus actual profit will be π = TR – TC = $aQ – bQ^2 – (c + dQ^2) = aQ – (b + d)\,Q^2 – c$

so, with reference to the profit maximising value of output in cell U5, this translates into the Excel formula in cell W5 in Figure 8 below.

The same procedure for deriving formulae for calculating each student's individual answer is then repeated for all questions in an assignment. When the full set of student ID numbers is pasted into column A these formulae are then simply copied down the worksheet page

The marking grid

If there are, say, about six questions in a coursework assignment, each with several parts, then this may entail a spreadsheet with over 50 columns when the columns breaking down students' ID numbers into their digits and the columns showing the actual numbers each student should be working with for each questions are included. For marking purposes, what is required is a simple grid that will fit in one page width (landscape if necessary) which just shows student ID numbers and the final answer to each question.

To create the Answer Grid:

- Label the worksheet page used to create students' answers as explained in the previous sections as 'Full Workings'.

- Go to the next worksheet page and label the tab 'Answer Grid'.

  Make a full copy of the Full Workings worksheet by typing = in cell A1 of the Answer Grid worksheet and then clicking on cell A1 in the Full Workings worksheet and hitting return.

- The formula box for cell A1 on the Answer Grid showing ='Full Workings'!A1 should then be dragged and copied over the whole of the Answer Grid worksheet until all the cells from the Full Workings worksheet are copied.

	A	B	C	D	E	F	G	H	...	O	P	Q	R	S	T	U	V
1																	
2										Q.2							
3										a	b	c	d	*MaxTR*		*Max π*	
4	**SID**									**5EF**	**1G**	**2H**	**0.8**	**Q**	*SOC*	**Q**	**SOC**
5	1234567	1	2	3	4	5	6	7	...	545	16	27	0.8	=O5/(2*Q5)	=–2*P5	=O5/(2*(P5+R5))	=–2*(P5+R5)

Figure 7. *(Note that the formulae for the calculated digits in columns B to R are not shown, and columns I to N are hidden, for clarity's sake)*

	A	B	C	D	E	F	G	H	...	O	P	Q	R	S	T	U	V	W
1																		
2										Q.2								
3										a	b	c	d	*MaxTR*		*Max π*		*Max π*
4	**SID**									**5EF**	**1G**	**2H**	**0.8**	**Q**	*SOC*	**Q**	*SOC*	**£ value**
5	1234567	1	2	3	4	5	6	7	...	545	16	27	0.8	17.03	– 32	16.22	– 33.6	=O5*U5–(P5+R5)*U5^2– Q5

Figure 8. *(Note that the formulae for the calculated values in columns B to H and columns O to V are not shown, and columns I to N are hidden, for clarity's sake)*

	A	B	C	D	E	F	G
1							
2		Q.1		Q.2			
3				MaxTR		MaxPR	
4	SID	Equil Q	Equil P	Q	SOC	Q	SOC
5	1234567	24.4	113.00	17.0	-32	16.2	-34
6	1235414	23.1	95.73	25.2	-22	23.5	-24
7	1235902	22.8	97.47	28.0	-20	25.9	-22
8	1238647	16.6	82.29	20.9	-28	19.8	-30
9	1240319	55.8	196.08	22.9	-22	21.3	-24

Figure 9. Answer Grid example

- Cells that were blank on the Full Workings worksheet will appear as zero so these can be cleared to tidy things up.

The columns that are no longer needed for the answer grid can now be deleted.

- For example, columns B to L only show intermediate steps and can be highlighted and deleted.
- The same applies to columns O to R and V on the original version of the Answer Grid worksheet although, of course, once columns B to L have been deleted the columns on the Answer Grid will automatically be relabelled.

The resulting spreadsheet page should appear something like Figure 9 below.

Other possible features

Although they are not spelt out in detail in this paper, some other features that can be built into answer grids are:

- Using the Excel IF function, e.g. to decide which, if any, of a range of investment projects should be chosen.
- Specifying one parameter which all students must refer to at the top of the spreadsheet so that it can be altered if required. For example, if students are given a Marginal Revenue Product function that depends on their ID number and asked to find the amount of labour to employ when the wage rate equals a certain value, then that value can be specified in the spreadsheet and changed if some students' answers fall into an unacceptable range, or when constructing a new assignment. If a parameter that is incorporated into all students' answers is specified in one cell at the top of the spreadsheet then, of course, the row must be anchored with the $ symbol when the formula referring to that cell is copied down the column.

Marking students' work

Marking simply entails reading across the row corresponding to each student's ID number to find the correct numeric answers. This is best done by putting a marker on the printed answer grid or by highlighting the relevant row on screen.

It is obviously up to each tutor using this system to decide what proportion of marks are allocated for clarity of explanation, comment on results, or for any other non-numeric aspects of the assessment task that this method allows, via manual marking, and the extent of any written feedback.

If students get an answer wrong then, if the point when their calculations started to go wrong is not obvious, it may be useful to go back to the Full Workings spreadsheet page to check the original numbers the student used and any intermediate stages in their calculations.

Occasionally a student may input an incorrect number when they start a question. As long as it can be established that this is an oversight, with just one or two incorrect digits being used, rather than the wholesale copying of another student's ID number, the lecturer can over-ride the system by entering the actual numbers the student has used over the formulae for generating the student's starting numbers. If the student has got the correct answer using an incorrect starting number, then the lecturer can make whatever mark deduction they think appropriate, although the student can still get feedback on how well they have used the relevant mathematical technique.

Results

At Coventry the overall pass rate for first year mathematics for economists rose by 17% when this new assessment method was introduced. Although, of course, a range of different factors will affect pass rates, these results are an encouraging sign that this method is having a positive impact. Also, in the module student satisfaction survey, 81% of students agreed that assessment methods were effective.

What emerged from the actual marking process was that several students lost marks from basic and careless errors, e.g. getting plus/minus signs mixed up when removing brackets, rather than the incorrect application of relevant mathematical techniques. Manual marking enabled the lecturer to highlight these errors so that students got relevant and appropriate feedback. This has helped students to see where they need to improve and/or take more care with their work. Although, perhaps, the lecturer time input is greater than with a fully automated online

computer marked set of assessments, this is balanced by the benefits of greater student feedback focused on where individual students need it. The extra marking time required is not that great, given that numerically correct answers can be marked relatively quickly and it is only the answers where mistakes have been made that require more time.

Plagiarism was virtually eliminated because, as well as each student having a different set of numerical questions to answer, they were also required to set out and explain each step of their calculations.

In the assessments used at Coventry it was also possible to construct spreadsheets to answer certain questions where spreadsheet answers were the most appropriate method to solve problems, e.g. when students needed to adapt the standard net present value model to deal with varying interest rates.

Application to other academic disciplines

This paper has just set out some examples of how this individualised mathematics assessment method can be applied to economics. The next steps will be:

• To use it for assessments in accounting, for example in problems where students are required to work out a company's profit/loss situation and the values of various financial ratios, and in finance, such as the estimations of the outcomes of futures trading.

• To try to work with colleagues in other academic disciplines where individualised basic numerical mathematics problems may be relevant to assessment, such as the sciences or engineering.

Conclusions

The use of Excel to generate individualised mathematics assignments has been used with some success at Coventry University. This paper has set out some guidelines for using this method, drawing on the experience at Coventry, for setting questions in an appropriate format, devising an Excel marking grid and using this grid for marking. The author plans to continue with this method in the future and welcomes feedback on both the methods set out in this paper and on any experiences that those who choose to adopt it may wish to share.

Excel marking grids based on the questions used at Coventry are available for other lecturers to use, on the condition that they are not made available to students.

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