The 'Individualised Accounting Questions' Technique: Using Excel to Generate Quantitative Exercises for Large Classes with Unique Individual Answers

Nnadi, M. and Rosser, M.

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AE120180r

The 'Individualised Accounting Questions' technique:
Using Excel to generate quantitative exercises for large classes with unique individual, answers

Matthias Nnadi

School of Management,
Cranfield University, Bedfordshire,
MK43 0AL, UK

Mike Rosser

Department of Economics, Finance & Accounting,
Coventry Business School, Coventry University
CV1 5FB, UK

Abstract

The 'individualised accounting questions' (IAQ) technique set out in this paper encourages independent active learning. It enables tutors to set individualised accounting questions and construct an answer grid that can be used for any number of students, with numerical values for each student's answers based on their student enrolment number. The individualised questions reduce the risk of collusion and thus allow tutors to set accounting coursework assessments that contribute to final grades so that students have an extra incentive to do them in their own time, drawing on teaching materials and helping them to develop competency. The method, also allows specific individualised feedback, and has been used successfully by the authors and found to encourage students to work independently.

1. Introduction

Educators generally agree that active learning is better than passive learning. This is especially true in subject areas such as accounting that require students to practise applying techniques to master them. A major challenge, however, is how to get all students to engage in this active learning, particularly weaker students who need to do more practice but who, paradoxically, can often put in less effort than the more able students.

Educators (e.g. Harrell et al, 1985) have argued that to encourage active learning students' effort should be associated with reward, normally with higher grades. Final examinations, or in-class tests, can provide some incentive and, of course, are necessary to ensure only competent students are awarded qualifications, but they only assess what the student knows and are not part of the learning process in themselves. Fogarty and Goldwater (1992) developed a programme of computer based tests that students could take when they felt ready, and repeat, with in-built features to ensure the same questions were not repeated. From an education viewpoint this was an improvement, as students could learn from their mistakes and refer to their notes and textbooks to help better understand methods that they had difficulty with. Others have since developed more sophisticated computer based test systems, but these still have some drawbacks:

i)   Most computer based tests are time constrained and, even if students are allowed to consult their notes, there may not be enough time to properly get to grips with techniques required which the student may not yet be familiar with.

ii)   Computer based self test systems can be very time consuming and costly to set up or to change the type of questions used.

iii)   Computer packages are often restricted to relatively short questions that do not allow changes to fit the class needs or that do not ask for student commentary on results.

iv)   Feedback from computer based tests is not personalised and is usually constrained to telling students if they are correct or not and presenting a model answer.

If a student is given a set of accounting questions to do in their own time, which is then manually marked by their tutor, the advantages are that:

i)   This allows the student to draw on teaching materials to help them learn how to tackle the questions and engage in active learning.

ii)   The tutor can set more realistic complex and time consuming questions that would not be suitable for conventional exams or time constrained on-line assessment.

iii)   The tutor is able to tailor the questions to fit their teaching programme.

iv)   Feedback can be personalised to each student's requirements.

However, if all students are given the same set of assessment questions they may collude. In particular this can be one of the learning and assessment challenges facing tutors who teach large classes (Ashworth, et al, 1997; Doran et al, 2011). One solution, suggested by Nnadi (2003), Blayney and Freeman (2008) and others, is to ensure that each student is set different questions. This supports Forgarty and Goldwater (1992), who advocate a system that shifts the responsibility of learning to the student. Discussing with other students the most appropriate methods to use may then actually become part of a student's learning process.

This paper sets out a relatively straightforward method by which tutors can develop individual accounting questions using Excel spreadsheets and students' ID numbers. By reducing the incentive to collude, tutors can allocate grades to coursework, thus giving students more incentive to practise techniques and enhance their learning. The idea of creating individualised questions is not new, but this particular individualised accounting questions (IAQ) technique allows tutors to develop questions that best assess the course they are teaching, using only basic Excel and without requiring them to develop a large bank of questions or to produce a sophisticated interactive on-line teaching package

2. The challenge of individualising accounting questions: methodological rationale

The method follows a similar technique to Rosser (2008), where answers are computed in a spreadsheet grid and numerical values depend on individual students' identification numbers. Given that the use of spreadsheets is now an essential feature of accounting education (Chandler and Marriott, 1994; Beaman et al, 2005), accounting tutors should have no real difficulties in creating these spreadsheets. This addresses the issue raised by Fogarty and Goldwater (2007) that the technical difficulty involved in the development of some instructional materials could make it difficult to achieve the needed result. Thus, a pedagogy

that is easy to use by both the students and teachers will yield the most beneficial outcome. Lehman and Herring (2003) developed 'an interactive electronic spreadsheet' that provided students with immediate feedback using an answer-until-correct approach, but this has limited applicability to basic financial accounting problems, does not individualise questions, and does not give customised feedback on why students may have got incorrect answers.

The IAQ method set out here can be used to assess a variety of accounting topics including financial statements analysis, budgeting, cash flow statement, income statement, balance sheet, investment appraisal techniques, and costing techniques.

3. Setting up for basic accounting problems using the IAQ method

The starting point is to obtain an electronic class list of student enrolment numbers (SEN). If this is not available then the tutor can just create and allocate a unique number to each student. However, using the SEN has the advantage over an especially generated set of numbers in that all students will normally have their number on their ID card and tutors will not have to worry about late enrolments, repeat students or those who lose an allocated number. A typical student enrolment number (SEN) in UK universities has seven digits, and this is what the examples in this paper are based on, although the method can easily be adapted for other SEN formats.

In a coursework assessments based on this IAQ technique, students are given clear instructions to fill their SEN into a grid so that each digit corresponds to a letter of the alphabet, as in the example in Table 1(a) for a student with a SEN of 2010001. Assessment questions then refer to these letters, with each student substituting in the corresponding number from the grid they have completed.

Table 1(a): Filling the SEN in the individualised coursework

Instruction:	Fill your SEN into the boxes below so that each digit corresponds to a particular letter of the alphabet.						
SEN	B	C	D	E	F	G	H
2010001	*2*	*0*	*1*	*0*	*0*	*0*	*1*

The reason why the alphabetic sequence starts with B rather than A is because the actual SEN is put in column A so the spreadsheet formulae refers to columns from B onwards.

Tutors then need to decompose the SEN into separate digits in different spreadsheet columns. There are various ways that this can be done with Excel, but perhaps the easiest, assuming the first student SEN is in cell A2, is just to paste the formula =MID($A2,COLUMN()-1,1) into each of the seven columns to the right of cell A2. Thus, using the set of formulae shown in Table 1(b) below will give the values shown in Table 1(c) in columns B to H if these formulae are copied down the columns.

Table 1(b): Decomposing student enrolment number (SEN) into using spreadsheet

	A	B	C	D	E	F	G	H
1	SEN							
2	2010001	=MID($A2, COLUMN() -1,1)	=MID($A2, COLUMN() -1,1)	=MID($A2, COLUMN() -1,1)	=MID($A2, COLUMN() -1,1)	=MID($A2, COLUMN() -1,1)	=MID($A2, COLUMN() -1,1)	=MID($A2, COLUMN() -1,1)
3	2010002							

Table 1(c): Decomposed SEN using spreadsheet

	A	B	C	D	E	F	G	H
1	SEN							
2	2010001	2	0	1	0	0	0	1
3	2010002	2	0	1	0	0	0	2
4	2010003	2	0	1	0	0	0	3
5	2010004	2	0	1	0	0	0	4

This process only has to be done once, the first time a lecturer uses this method, and then this section of the spreadsheet can be saved for future use for other sets of questions..

To provide each student with their unique questions, the tutor only needs to produce one question sheet that can be given to the whole class. This should contain some instructions and information for students, along the lines:

- The values you need to use to answer the questions below will depend on your student enrolment number (SEN)

- Please enter your SEN in the grid below. (*Tutor provides a grid as in Table 1(a)*)

- You should then write in values for each question corresponding to the letters above each digit in your SEN. For example, if your SEN was 1234567 then an amount specified in a question as £2G, H00 would be £26,700.

- Write the relevant numbers that correspond to your SID in the spaces in the brackets before you start answering each question.

If tutors then set out questions as in the examples in Section 5 below, leaving a space for students to write in their own values corresponding to their SEN digits, then each student will have a unique set of numerical questions to answer.

4. Dealing with complexities in SEN

 A few precautions may be needed to ensure that all students arrive at acceptable answers. If we simply let digits in a student's SEN represent all specified variables, such as the interest rate, this could cause problems, particularly if a digit is zero. For example, for SEN 2010001, then if digits FG represented the interest rate in an investment appraisal problem, inputting an interest rate of 0.0% may give an unrealistic problem to solve.

To avoid this sort of problem it is often best to give students problems with numbers that are a mixture of given digits, that will be the same for each student, and digits that will depend on their SEN. For example, the interest rate could be specified as 4.EF%. This would mean student number 201000 would use 4.00%, which is realistic, and other students would have interest rates within a close range but not all the same. In a large class some students might still have the same interest rate in an example like this, but if there are also other individualised values, such as the amount invested, this will ensure more differentiation of answers. If Excel formulae are just copied down the spreadsheet page then it is then easy to spot if any unrealistic or confusing answers are computed for particular students' SEN and then make any necessary adjustments.

5. Applications of the IAQ Method

Some simple examples below illustrate different possibilities for the application of this technique. However, for actual questions given to students, tutors may extend and combine these different approaches to make assessments more challenging.

Example 1 **Using IAQ to Create an Income Statement Exercise**

Question: Find the gross and net profits of XYZ Ltd given
                    Trial balance as at 31st December 2013

	£'000
Sales	11,2EH
Opening inventory	1, G00
Purchases	4, H00
Selling and admin expenses	G, D50
Closing inventory	1, G50

Tutor's spreadsheet for marking:

Firstly, create the values that each student needs to work with for the above five variables by putting appropriate formulae in columns I to L, with expenses in column N. These formulae need to refer to the relevant SEN digit in columns B to H, multiplying up as appropriate. For example, the digit in column E has to be multiplied by 10 in the Sales formula.

Secondly, create formulae for the Gross and Net profit in columns M and O that will compute answers based on the initial values in columns I to M and N. Table 2(a) below sets out appropriate formulae for this question in row 2.

Table 2(a) Programming IAQ for income statement

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	SEN								Sales	Open. inv.	Purch.	Closing inv.	Gross profit	Expenses	Net profit
2	2010001	2	0	1	0	0	0	1	=11200+E2 *10+H2	=1000+G2 *100	=4000+ H2*100	=1000+G2 *100+50	=I2- ((J2+K2)- L2)	=G2*1000+ D2*100+50	=M2- N2
3															
4															
5															
6															

The formulae in cells I2 to O2 can now be copied down the worksheet page so that answers are generated for whatever set of SEN is pasted into column A. The actual spreadsheet with values giving answers for each student SEN will then appear as in Table 2(b).

Table 2(b) Programmed IAQ solutions of income statement

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	SEN								Sales	Open. inv.	Purch.	Closing inv.	Gross profit	Exp.	Net profit
2	2010001	2	0	1	0	0	0	1	11201	1000	4100	1050	7151	150	7001
3	2010002	2	0	1	0	0	0	2	11202	1000	4200	1050	7052	150	6902
4	2010003	2	0	1	0	0	0	3	11203	1000	4300	1050	6953	150	6803
5	2010004	2	0	1	0	0	0	4	11204	1000	4400	1050	6854	150	6704
6	2010005	2	0	1	0	0	0	5	11205	1000	4500	1050	6755	150	6605
7	2010006	2	0	1	0	0	0	6	11206	1000	4600	1050	6656	150	6506
8	2010007	2	0	1	0	0	0	7	11207	1000	4700	1050	6557	150	6407
9	2010008	2	0	1	0	0	0	8	11208	1000	4800	1050	6458	150	6308
10	2010009	2	0	1	0	0	0	9	11209	1000	4900	1050	6359	150	6209
11	2010011	2	0	1	0	0	1	1	11201	1100	4100	1150	7151	1150	6001
12	2010012	2	0	1	0	0	1	2	11202	1100	4200	1150	7052	1150	5902

Once set up, this spreadsheet can be adapted and extended for other balance sheet questions.

Example 2 **Using IAQ to Create a Depreciation Rate Exercise**

Question: A company calculates the depreciation of its assets on straight line basis. The following are its non-current assets as at 31st December 2013 :

- Machinery at cost   £100,000
- Vehicles at cost   £85,000
- Furniture & fittings   £54,000

Calculate the depreciation value for each asset if a straight-line deprecation charge of 2H% is applied.

Tutor's spreadsheet for marking:

Columns A to H are identical to the previous spreadsheet because they are just the digits derived from students' ID numbers to be used in the calculations. As all students need to

work with the same initial asset values, these can all be entered in row 2, cells J2 to L2. Thus the SEN and other variables and formulae now start in row 3 in this example. In cell I3, the 2H% depreciation rate is created by adding 20 to the digit in H3 (e.g. 20 +1 = 21) and dividing by 100 to convert to a percentage. Next, in cells J3 to L3 the depreciation values for each asset are calculated by multiplying the depreciation rate by the asset values which in row 2, as in Table 3(a).

Table 3(a) Programming depreciation rates using IAQ

	A	B	C	D	E	F	G	H	I	J	K	L
1	SEN								Depreciation	Machinery	Vehicle	F&F
2									rate	100,000	85,000	54,000
3	2010001	2	0	1	0	0	0	1	=(20+H3)/100	=I3*J$2	=I3*K$2	=I3*L$2
4												

The $ symbol is used to anchor the row 3 asset values so the formulae in cells I3 to L3 can be copied down the spreadsheet to generate answers for each student ID number, giving answers as in Table 3(b) below.

Table 3(b) Depreciation rates using IAQ

	A	B	C	D	E	F	G	H	I	J	K	L
1	SEN								Dep.	Machinery	Vehicle	F&F
										100,000	85,000	54,000
2	2010001	2	0	1	0	0	0	1	0.21	21000	17850	11340
3	2010002	2	0	1	0	0	0	2	0.22	22000	18700	11880
4	2010003	2	0	1	0	0	0	3	0.23	23000	19550	12420
5	2010004	2	0	1	0	0	0	4	0.24	24000	20400	12960
6	2010005	2	0	1	0	0	0	5	0.25	25000	21250	13500
7	2010006	2	0	1	0	0	0	6	0.26	26000	22100	14040
8	2010007	2	0	1	0	0	0	7	0.27	27000	22950	14580
9	2010008	2	0	1	0	0	0	8	0.28	28000	23800	15120
10	2010009	2	0	1	0	0	0	9	0.29	29000	24650	15660
11	2010010	2	0	1	0	0	1	0	0.20	20000	17000	10800

Example 3 **Using IAQ programme in investment appraisal**

Each student can be allocated different cash inflows values, as in the investment appraisal example below:

Question: A company is considering investing £25,000 in a production project with cash inflows projected for 3 years as follows:

Year   Cash inflow

1   1H, 500

2   1H, G00

3   1H, D00

Calculate the net present value (NPV) of the project assuming the cost of capital is 9%.

Tutor's spreadsheet for marking:

In this example the first digit in each cash flow is a given numeric value, corresponding to £10,000,. This ensures all students will have cash flow values of at least this amount, in order to give realistic answers and also ensures no cash flows are zero, which might occur if only letters from the student ID are used. This example also sets the initial cost at a level that will give some students a negative NPV and some a positive value, thus ensuring diversity of answers. Tables 4(a) and (b) present the programming and solutions to this question..

Tables 4(a) Setting up NPV calculations

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1									Cost =	25000		0.09				
2	SEN								Yr.1	Yr.2	Yr.3	DF@9 %	PV-1	PV-2	PV-3	NPV
3	2010001	2	0	1	0	0	0	1	=10000+ H3*1000+ 500	=10000+ H3*1000+ G3*100	=10000+ H3*1000+ D3*100	=1/(1+ L$1)	=I3*L 3	=J3*L 3^2	=K3* L3^3	=SUM(M3:N3) -J$1

Tables 4(b) Individualised NPV solution for each student

	A	B	C	D	E	F	G	H	I	J	J	K	L	M	N	O
1	SEN								Yr.1	Yr.2	Yr.3	DF@9%	PV-1	PV-2	PV-3	NPV-A
2									Cost =	2500						
3	2010001	2	0	1	0	0	0	1	11500	11000	11100	0.91743	10550	9258	8571	-5191
4	2010002	2	0	1	0	0	0	2	12500	12000	12100	0.91743	11468	10100	9343	-3432
5	2010003	2	0	1	0	0	0	3	13500	13000	13100	0.91743	12385	10942	10116	-1673
6	2010004	2	0	1	0	0	0	4	14500	14000	14100	0.91743	13303	11784	10888	86
7	2010005	2	0	1	0	0	0	5	15500	15000	15100	0.91743	14220	12625	11660	1845
8	2010006	2	0	1	0	0	0	6	16500	16000	16100	0.91743	15138	13467	12432	3604
9	2010007	2	0	1	0	0	0	7	17500	17000	17100	0.91743	16055	14309	13204	5364
10	2010008	2	0	1	0	0	0	8	18500	18000	18100	0.91743	16972	15150	13977	7123
11	2010009	2	0	1	0	0	0	9	19500	19000	19100	0.91743	17890	15992	14749	8882
12	2010010	2	0	1	0	0	1	0	10500	10100	10100	0.91743	9633	8501	7799	-6866

In the NPV example above only the cash inflow values vary but the cost of capital or the initial cost could also be altered to reflect the SEN. Other investment appraisal exercise, such as accounting rate of return, payback period and internal rate of return, can also be set up using a similar process.

6. Creating a marking grid

Where an accounting assessment has different questions, the spreadsheet may involve a large number of columns which will not easily display on a screen. To make the marking process easy, a simple grid that shows just the student enrolment numbers and the final solutions that will fit in one page (landscape if necessary) can be created. Rosser (2008) outlines a simple process as follows:

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

• Label the next worksheet page 'Answer Grid' and make a full copy of the Full Workings page by typing = in cell A1 of the Answer Grid worksheet, then clicking on cell A1 in the Full Workings page, and then dragging and copied this formula over the whole of the Answer Grid worksheet until all the Full Workings worksheet is copied. Cells that were blank on the Full Workings worksheet will appear as zero and can be cleared to tidy things up.

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

The calculations in the NPV example above can be abridged by this method to show only the student enrolment numbers (SEN) and the NPV values on the Answer grid page, as shown in Table 6 below.

Table 6   Marking Grid

	A	B
1	SEN	NPV
2		
3	2010001	-5191
4	2010002	-3432
5	2010003	-1673
6	2010004	86
7	2010005	1845

It is usually best to mark from this grid on screen rather than printing it, as the tutor can easily switch to the "Full Workings" spreadsheet page if they wish to try and see why a student has computed a wrong answer. For incorrect answers, the tutor can then check:

a) If students started off with the wrong number

b) At what stage the answer started to go wrong.

Although (a) may possibly happen if the work of another student has been copied, the evidence suggests that this is a usual occurrence, and instances of the wrong number being used are usually due to carelessness in copying a digit from the student's own ID number. If this happens then tutors can allow for the input error by punching in the starting number the student actually used, seeing if the student's answer is correct based on this and then mark as normal, just deducting an appropriate penalty for incorrect inputting. This gives much better feedback to students on their ability to apply accounting methods than an automated system that would just tell the student their answer was wrong.

7. Conclusion

The IAQ technique set out in this paper is a relatively simple method of individualising questions using basic Excel skills that can have a very positive effect on student engagement in active learning. It has been used regularly by the authors and others and found to be very

effective, with the end result of improved student performance and better understanding of accounting methods.

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