

Developing a new model for awarding AS & A Levels in Mathematics and Further Mathematics

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Background

When the proposal to replace AS and A Levels in Mathematics and Further Mathematics with multiple-unit awards was made earlier this year, it attracted widespread condemnation from across the whole mathematics community.

The original model was unsound, making it likely to be disadvantageous for students to take more than the minimum amount of mathematics they could get away with. It was thus in direct conflict with national needs and with government policy.

Rather than abandon it as a bad idea, those responsible tried to adapt it to meet people's concerns. The full revised model would not seem to be available as a single document. It is in part described in the latest version of the paper "Grading GCE Mathematics and Applied GCE subjects" and in part has to be inferred by the worked examples provided by QCA. In the rest of this document the combination is described as the QCA model.

The lack of definition of the QCA model has caused real difficulties for us in preparing this paper. It is, for example, unclear whether it is the intention to give information about AS and A Level grades alongside those for multiple-unit awards.

Commentary on the QCA model

A number of serious flaws remain in the QCA model. If unresolved, any one of these should prevent the scheme going ahead.

- Its outcomes have now become so complicated that end-users will be unable to interpret them. Indeed, it is entirely predictable that some students will also be baffled by it and so will make inappropriate choices.
- It will not be possible to change specifications between Mathematics and Further Mathematics, something that is widely done at present.
- The model is based on a best-best awarding process rather than a least-best. As a result, some Further Mathematics candidates appear to receive unduly low grades in the Further Mathematics part of their profiles.
- A more fundamental problem is that students will be taking A Levels in physics, chemistry and English but something different in mathematics. The fear is that this will have the effect of deterring some people from taking mathematics, making it seem to be a subject that there is something not quite right about. The risk of this happening, at a time when mathematics is just recovering from Curriculum 2000, is much too great even to be contemplated.

In addition, a serious (but not fatal) criticism of the QCA model is that it will encourage Further Mathematics students to keep re-sitting early units to generate extra surplus marks to boost their uniform mark (UMS) totals for qualifications including Further Mathematics.

An improved model

Despite this negative reaction to the QCA model, it does in fact include features which could lead to an improved model that would also be better than the existing method.

The QCA model would provide a candidate with progressively changing certifications. This is a powerful idea and QCA are to be commended for it. It is developed further in the proposal which we are making. This is explained using the following example.

A candidate takes 12 units, 3 new units at each January and June sitting over a 2-year period together with some re-sits. In the present system this candidate would have been awarded grade A for Mathematics and grade C for Further Mathematics. A possible profile of outcomes from the QCA model is shown in the Table 1.

Qualifications awarded					
	3-unit	6-unit AS Level	6-unit A Level	9-unit	12-unit
Year 1 Jan	B				
Year 1 June	A		C		
Year 2 Jan	A	B	B	BC	
Year 2 June	A	B	A	AB	BC

Table 1 Outcomes from the QCA model

In the QCA model, the candidate might receive as many as than 12 certifications over the course of the two years. How many of these are necessary or helpful?

There are just 2 results that this candidate would want to hold on to for later life: grade A in A Level Mathematics and grade C in A Level Further Mathematics. By contrast the final row from Table 1 is remarkably unhelpful. This is the candidate's final set of certifications but whatever information is contained in the sequence A, B, A, AB, BC is obscure. How is an admissions tutor or an employer expected to evaluate it for an applicant whose other subjects are all graded conventionally? And what useful purpose, if any, is served by the other 7 certifications?

It is manifest that these multiple-unit grades provide less information than the equivalent AS and A Level grades. So why have them? The answer would seem to be that they are a device for extricating mathematics from the restrictions of the no-decline rule.

Is there a better way of doing this? At first sight it would seem that the simplest answer would be simply to exempt mathematics from the no-decline rule, and it may be that this will turn out to be a good thing to do anyway. However, putting that thought on one side for the moment, are there other alternatives?

Using the same idea of progressive certification as would be used in the QCA model, but giving AS and A Levels rather than multiple-unit awards would give the set of certificates in Table 2.

	AS Maths	A Maths	AS FM	A FM
Year 1 Jan	B			
Year 1 June	A	C		
Year 2 Jan	A	B	C	
Year 2 June	A	A	C	C

Table 2 Outcomes from a progressive certification model for AS & A Levels

However, any certificates in the first 3 rows, resulting from earlier sittings, are likely to be superseded by those in the final row from the final sitting. So those early certificates have no long-term meaning.

Nonetheless, the information in the first three rows of the table may well be very useful.

- It could be helpful to students at the time they are applying for university places.
- Some colleges may find it useful when claiming LSC funding, even though it is not strictly necessary.
- Schools and colleges may well find it valuable for their internal monitoring.

Important though these points may be, none of them requires actual certification. Instead the same information could be provided, using the same computer systems, as Statements of Entitlement.

Certification would only happen on request and this would be made at the time of final entry, as is common practice in many schools today. Since the only certification would occur at the end of a course of study, the no-decline rule would be irrelevant.

The final certification would, as at present, be based on a least-best rule. This ensures that candidates for A Level Mathematics and AS or A Level Further Mathematics receive the best possible pair of grades.

A new feature, which is made possible by the revisions to the original QCA model, is that at the final certification an optimisation process is carried out. This has two purposes.

- It ensures that any spare (unallocated) units which are better than those used in the present least-best aggregation are used if it is possible to do so within the rules governing the various subject awards (e.g. C1, C2, C3 and C4 must all be present in A Level Mathematics).
- It also ensures that, within the rules, the allocation for the best pair of grades is that which gives the greatest uniform mark total (UMS) to A Level Mathematics.

Table 3 shows the outcomes under this model.

	AS Maths	A Maths	AS FM	A FM	Outcomes
Year 1 Jan	B				Statements of Entitlement
Year 1 June	A	C			
Year 2 Jan	A	B	C		
Year 2 June	A	A	C	C	Certificates

Table 3 Outcomes from the developed model

The outcomes could be simplified further by incorporating a rule under which A Levels overwrite AS Levels. While it can be argued that this would be a desirable thing to do, it would cause confusion if mathematics was the only subject to adopt such a procedure and could well deter some students from taking mathematics.

Questions and answers

This model has many compelling features. These are explained in the following set of questions and answers.

Does this model change the qualification titles with which users are familiar?

This model retains the existing qualification titles and grades, maintaining the confidence of users and avoiding the risks inherent in any change of qualification titles and grades.

Is this model transparent?

Yes. Candidates are given full information, in the form of Statements of Entitlement, at every stage. The qualifications awarded are determined by the qualification entries made, so there can be no surprises.

How will it affect schools and colleges?

Many people will hardly notice that any change has taken place at all. The only change in practice will be that those schools and colleges that currently apply for certification at an intermediate stage in a course will no longer do so. Instead they will automatically receive Statements of Entitlement.

How will it affect end-users?

It avoids a confusing plethora of outcomes. End-users will not have to apply a different set of criteria to mathematics from those for comparable subjects. The outcomes that it does provide will be genuinely useful to many people, including the candidates themselves; the only certificates to be issued will be those that they will need to keep.

Would any candidates get different qualification grades from those awarded under the present system?

No, the qualifications and associated grades will be the same (e.g. AS Further Mathematics grade C). However, the optimisation process will ensure that, within the rules governing the qualifications, a candidate's best units are used. This may result in a different allocation of units to a qualification, and so different UMS scores but the UMS total will still lie within the same grade band.

Why not stick to the present least-best-across-the-board approach rather than the modification suggested here?

The present least-best model provides the best grades available to a candidate. It can however, result in good, extra units not being allocated and this could act against a candidate being considered for university admission, now that unit grades are being made available to admissions tutors.

Is this model likely to affect the numbers studying mathematics and how much mathematics they study?

No, there is no possible reason for this model to diminish the numbers studying mathematics and how much mathematics they study. It avoids the risks caused by the averaging of grades in using the multiple-units system and it removes the disincentive to studying extra units which has arisen in the present least-best system now that unit grades are reported to UCAS. It also, crucially, retains the perception of mathematics being the same as other comparable subjects.

Does this model introduce incentives to increase the number of re-sits?

The model does not encourage more re-sits than with the present least-best model. It would not be possible (as it would be with the multiple-units model) to generate extra surplus marks on A Level Mathematics and then use them to boost the UMS total for qualifications including Further Mathematics.

Why does the model give preference to qualification grades over unit grades and UMS totals?

It is the qualification grades that will have long-term value to candidates. Indications are that even universities will look at qualification grades first (and it is these for which they will receive predicted grades) and unit grades will be used only by some departments to discriminate among those with the same qualification grades. Many of those recruiting for employment will consider only qualification grades and be unaware of the subtleties of the system. In designing an awarding system, one must recognise that many users will have only a partial knowledge and understanding of it, and that may well be out of date; to achieve even partial awareness of changes requires extensive publicity. By preserving qualification grades, only 'expert' end users need engage with the changes and there is no need for a large-scale information campaign, now and when early cohorts are leaving university, as would be required with a switch to a multiple-unit system.

What happens subsequently to candidates who are entered for certification before the end of their sixth form study of mathematics?

The optimisation model can provide an escape-route for such a candidate. When more than one qualification is awarded at the same time then any units previously tied to any of those qualifications would be made available for award to any of the qualifications being certificated at that time. So a candidate who had previously been certificated for A Level Mathematics who now wished to be certificated also for AS Further Mathematics would enter again for A Level Mathematics as well as entering for AS Further Mathematics; this would put the units previously tied to A Level Mathematics into the pool of units available to the optimisation process when making both awards.

Does the model allow sharp practice over the number of units sat?

No. With all certification at the end, there is no possibility for claiming qualifications on fewer than the requisite number of units (as has happened in the past). However, it will be important that the present restrictions regarding AS and A Level Pure Mathematics remain in place: these make it impossible to claim any qualification in Mathematics or Further Mathematics in combination with A Level Pure Mathematics.

How would the model work if a candidate took Mathematics and Further Mathematics in different specifications?

The use of the model would not affect current procedures for dealing with candidates in this situation.

What does the model do for the unit grades reported through UCAS?

Once qualification grades have been maximised, in the final optimisation the model maximises the UMS scores within them, starting with Mathematics and then going on to Further Mathematics. The final optimisation also ensures that any spare units a candidate may have are used to best effect, something that does not happen at present.

Will candidates' UMS totals for A Level Mathematics be the highest possible?

If the candidate is not entering for certification in a Further Mathematics qualification at the same time then the model will always give the highest possible UMS total for A Level Mathematics. Where there is also a Further Mathematics qualification entry, the UMS total for Mathematics will generally be the highest possible subject to the condition that the best possible Further Mathematics grade is awarded. (The model puts optimising qualification grades above the detailed results within particular qualifications, as happens at present.)

Some UK Higher Education offers are said to require a UMS score of at least 540, how does this model help applicants with such offers?

This model will ensure that a candidate for A Level Mathematics will receive the highest possible UMS score and so the best chance of meeting such an offer, unless that would be at the expense of a grade in a higher qualification.

Such offers are believed to be rare. An internet search revealed no universities making such offers and the careers department of a highly academic sixth form college which receives about 6000 course offers a year was unaware of any of its students receiving such an offer. Informal enquiries have found only one university department which makes such offers; its standard offer to those taking only A Level Mathematics is (AAA) or (AAB with 540+ in A Level Mathematics). As this offer is not given to those taking Further Mathematics, issues of optimisation between qualifications do not arise, so this model will always give the best possible UMS score for such candidates. Further, the department concerned expects in the coming year to change the additional requirement on the AAB offer to one of scoring an A grade in each of the Core units.

If other departments are identified as making 540+ offers, it is suggested that appropriate bodies within the mathematics community might discuss with them the alternative of using unit grades, especially in the core units which are taken by all candidates for A Level Mathematics.

Some overseas higher education offers require a UMS score of at least 540, how does this model help applicants with such offers?

The number of candidates holding such offers is not known but is believed to be very small relative to the size of the cohort. As said above, this model will ensure that a candidate for A Level Mathematics will receive the highest possible UMS score and so the best chance of meeting such an offer, unless that would be at the expense of a grade in a higher qualification. So only an applicant who was taking Further Mathematics could be at greater risk from this model than a best-best model (such as the one in the multiple-unit proposal) of meeting an offer, and this would not be the case if the university made an alternative offer incorporating Further Mathematics.

Given the wide variety of university entrance arrangements overseas and the difficulty of determining the numbers involved, it is difficult to see how it is practical to take into account the interests of the candidates involved in a way which is useful and proportionate.

The University of Cambridge asks applicants for the UMS scores for all units taken, how does this model help applicants to that university?

The form referred to here asks for all GCE unit scores whether used in aggregations or not, and so is unrelated to issues of aggregation.