

LTC12D149

Title: New Academic Model: Rounding of Marks
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Issue

To consider the different options available for the rounding of marks and display of decimal places for marks in the New Academic Model.

Recommendation

LTC members are asked to consider the options and approve either the recommended options, or alternative options.

Resource Implications

None

Risk Implications

None

Equality and Diversity

It is not envisaged that the recommendations contained in the report will impact on groups with protected characteristics.

Timing of decisions

The report reflects discussions at the TPPG meeting on 5 June 2013, and subsequent feedback from colleagues. The options approved by this LTC meeting will be incorporated into the New Academic Model regulations, also under consideration for approval at this LTC meeting.

Further Information

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Background

As indicated in the report

Discussion

As indicated in the report

Attachments

- 1) the report 'NAM rounding marks and decimal places' including an appendix on 'Mark Rounding' written by the Chair of the ECO Board of Examiners
- 2) comments received from Chairs of Boards of Examiners, Teaching Directors and other interested parties following consultation around the time of the June TPPG meeting.

The New Academic Model, Decimal places and Rounding Marks

Introduction

The original 'features of the New Academic Model' endorsed by Senate, following discussion at LTC on 27 April 2011, included 'item and module assessment marks to be recorded as integers and year and degree aggregates to one decimal point'. The consideration of this precedes the introduction of New Academic Model (NAM), and was originally proposed for introduction in 2008/9. However, with NAM on the horizon, it was decided to postpone implementation and to include it as one of the principles of NAM.

As we are finalising the regulations for the NAM, colleagues have expressed concerns about the proposed change to the number of decimal places, in two diametrically-opposed directions. Some Chairs of Boards of Examiners have expressed a desire to move to integers for year and degree classification marks, in addition to module marks, and others have expressed concern about the rounding that will inevitably occur if marks were recorded as integers and have expressed a desire to keep the two decimal places for all marks.

In addition to these concerns, it is noted that another 'feature of NAM' is that 'straight SITS output to be used for Board of Examiners paperwork'.

Following receipt of these concerns, some extensive work and testing has been carried out to check how the Student Information System (SITS) records and calculates marks, and to judge what effect this may have on students' outcomes.

Discussion at TPPG

A version of this paper was considered by TPPG on 5 June. The Group concluded that its preferred option, and the one that it would recommend to LTC, would be to stick with the two decimal places. However, since the TPPG meeting took place, a further refinement has been proposed, and it is this further refinement which is now the recommendation put to LTC.

Arrangements in SITS

The Student Information System (SITS) stores marks at four separate stages of a student lifecycle. These marks include: the assessment item mark, the module mark, the stage average mark and the classification mark. In the current CCS regulations these are all stored to two decimal places. The system works as follows, for the two concerns raised:

Stage and Classification Marks

In the original NAM proposal it was agreed that Stage and Classification marks would be displayed to one decimal place, following consultation in 2007/8, and regular feedback from some external examiners that classification marks should be integers. SITS records these marks on the system to 2 decimal places (2DP) and there is no

ability to control or alter this within SITS. (This was not considered an issue at the time of the original consideration perhaps because either we did not go into this amount of detail, or we thought that we could get this could easily be changed by the software suppliers).

Module Marks

In the original NAM proposal, it was agreed that the assessment item and module marks will be rounded to an integer. In SITS it is possible to define the number of decimal places to be used at the item and module level (although the number of decimal places must be the same in both cases).

Rounding works in the normal way ie 5 or above is rounded up, below 5 is rounded down, as illustrated below:

Actual Mark	Rounded mark
76.20%	76%
76.49%	76%
76.50%	77%
76.70%	77%

If the system is set to 0 DP (integers), when a fractional mark is entered, or computed, in the system, only the rounded mark is stored, as in the following example:

Assessment	Mark input (achieved mark)	Mark recorded	% weighting
Coursework 1	45.5	46	30
Coursework 2	56	56	30
Exam	77.5	78	40
Overall weighted module mark	61.45	62 (using the rounded marks above the module mark would be 61.8, which would be rounded to 62)	

If the mark schemes are set to integers, there will be rounding at the assessment item level and again at the module level. The difference in this example is 0.55 upwards, although the same principles would apply to downward rounding.

For the calculation of the overall module mark, SITS will use the recorded mark; the achieved mark is lost at the point of storing on the system. This will change the overall module mark, so that in this example, when using integers, the mark would be 62, but the actual achieved module mark is 61.45

Reporting from SITS

It is not technically possible to store the stage average and classification marks as integers; they will always be stored to 2DP in the System. If we choose to display this information to the Boards of Examiners as integers we will have to continue to manipulate the data coming out of SITS for the Board paperwork, something we want to avoid, as stipulated in one of the principles of NAM.

We are unable to use 'straight SITS output to be used for Board of Examiners paperwork' if we are to show Stage averages and Classification marks to integers or to one decimal place.

Implication of using integers at the assessment and module level

In SITS, marks are stored at two levels within a module; the assessment item level and the overall module level. In the NAM it is envisaged that both these marks will be rounded to an integer value and therefore will not use decimal places.

Currently assessment item marks may be fractions, particularly in exam and course test assessments, and module marks are very often fractions, being made up of several different weighted items.

An example picked at random from 2011/2 (ENV-1A28)

	Coursework	Exam	Overall Module Mark
	33%	67%	
Student 1	59	60.5	60.01
Student 2	52	57	55.35
Student 3	74	71	71.99

With rounding, the marks would be:

	Coursework	Exam	Overall Module Mark
	33%	67%	
Student 1	59	61	60
Student 2	52	57	55
Student 3	74	71	72

This illustrates that an unfortunate student may be deducted fractions of marks throughout his counting years, and a fortunate student may be awarded fractions. This could add up to a significant difference in outcome for these students, whose original marks may have differed very little. The Chair of the Board of Examiners in ECO has worked through some examples, and his paper is attached in the Appendix.

Another concern is that with the possible change in outcome for some students, rounding may increase the number of queries and appeals raised by students. Students will work out the module mark (and associated Stage and Classification mark) from their original coursework mark, and their exam mark, and see that they have lost marks. Those that just miss out on consideration for upgrade (those who may move down to the 67% classification mark, from 68% if we kept to 2DP throughout) may appeal, and in considering the appeal we would want to look at the original achieved marks, which we have not recorded, as the marks stored on the system are rounded. It is important that the mark that the student receives on their coursework matches what is stored in SITS and what is displayed to students on eVision and on the students' HEAR reports.

Implications of using integers for the Stage Average Mark

The stage average mark represents the average mark of the module results for a specific stage, normally equating to year, of study, using the module credit to determine the appropriate weighting. The system calculates the stage average to two decimal places and this cannot be overridden. If we adopt the use of integers at the module and assessment item level, the marks used to calculate the stage average will be the integer value of the modules, computed from the rounded assessment item marks; as stated previously, the fractions of marks are lost on storing.

We display the stage average mark on the students' annual mark statements and on the Exam Board paperwork. Any requirement to display the stage average mark in a different format to that stored in SITS will require additional manipulation of the data outside of SITS, with associated additional resource. For the mark statement this would involve writing a code in the SITS reporting tool to artificially round the stage mark, and then display it as a whole number. For Exam Board reports, it involves setting up the reporting tool used (currently Discoverer) to artificially round the marks and display them to the different configuration. It would mean that the information displayed to the student and to the Board may not be the same as that stored in the Student Information System, and that is a risk when it comes to auditing the system, historical records, and may produce student queries.

Classification Mark

The classification mark is calculated separately from the stage average by using the student module results stored in SITS. Although the classification does establish the stage average for each level it uses, it does not round that mark until the end of the process. The classification therefore runs through the following events (for 40:60 classifications):

- 1) Calculates the Stage Two Average using the Module marks by calculating the sum of marks divided by 120 credit and then multiplying by 40/100 to give the 40% share.
- 2) Calculates the Stage Three Average using the Module marks by calculating the sum of marks divided by 120 credit and then multiplying by 60/100 to give the 60% share.
- 3) At this point SITS will add the two results together to get a classification mark.

The system calculates the classification mark to two decimal places and this cannot be overridden.

We display the classification mark on the student transcript and on the Exam Board paperwork.

Any requirement to display the classification mark in a different format to that stored in SITS will require additional manipulation of the data externally to the system, with associated additional resource in the same way as it would for the Stage Average Mark. It would mean that the information displayed to the student and to the Board may not be the same as that stored in the Student Information System, and that is a risk when it comes to auditing the system.

With the introduction of the HEAR (Higher Education Achievement Report), the classification mark on the system will be recorded on the student's HEAR (which will replace transcripts). If we go ahead with the proposed change in the number of decimal places for reporting, a Tribal development to round the mark and display as an integer on the HEAR would be required.

It would be possible to display information to the Board of Examiners in a different configuration to the two decimal places on the system. However, if it is accepted that the mark that is displayed to the student through the mark statement and transcript/ HEAR is the same as that stored in the system, it seems to be of little benefit and potential risk, to manipulate marks for display to the Board with a reduced number of decimal places.

Options

Module and Assessment Item Marks

1. Keep all module and assessment item marks recorded to two decimal places, but for the purposes of progression, module marks will be treated as if rounded to the nearest integer; module marks within 0.5% of a pass will be awarded a pass.

This rounding will be programmed into the progression rules in the Student Record System.

Advantages:

- No marks are 'lost'
- Students would not be disadvantaged, so fairness and equity would continue
- Keeping the same configuration as the current set up will simplify transitional arrangements and reporting.

Disadvantages:

- Although it is in the spirit of the previously-agreed principle of NAM, in that the marks will be considered as integers at those boundaries where it matters, there may be some confusion and perceived discrepancy between the *result*, which will be based on the integer, and the *actual* recorded mark, which will be to two decimal places. For example, a mark of 39.5 will have a result of 'Pass'. It is suggested that a sentence of explanation regarding the rounding is incorporated into Marks Statements and on the HEAR.

2. Keep all module and assessment item marks recorded to two decimal places.

Advantages:

- No marks are 'lost'
- Students would be neither advantaged or disadvantaged, so fairness and equity would continue
- Keeping the same configuration as the current set up will simplify transitional arrangements and reporting.

Disadvantages:

- Students who fail a module by up to 0.5% would be required to be reassessed, whereas if module marks were integers the same students would pass the module, with no requirement to be reassessed.
 - Goes against a previously-agreed principle of NAM

3. Record module and assessment item marks as integers on the system, and on all documentation to the student and Exam Board.

Advantages:

- Previously-agreed principle of the NAM regulations.
- Some students would be advantaged.
- It is technically possible to implement on SITS, so there would be no issue with having to manipulate data between the system and outputs.

Disadvantages:

- Fractional marks are not stored on the system and will not be taken into account for overall marks and averages. They will also not be available for any consideration of appeals.
- Some students may be disadvantaged due to rounding down
- Students may query/appeal module marks which effectively reduce their overall marks with continual rounding down.
- Goes against a previously-agreed principle of NAM

Recommendation:

To implement option (1), keep all module and assessment item marks recorded to two decimal places, but for the purposes of progression, module marks will be treated as integers; module marks within 0.5% of a pass will be awarded a pass.

Stage Average Marks and Classification Marks

(Noting that all such marks will be recorded to two decimal places on the system).

1. Display stage average and classification marks to two decimal places on all documentation to the student and Exam Board. For the purposes of progression and classification, stage average and classification marks will be treated as integers:
 - (a) Stage average marks within 0.5% of a progression boundary will be considered to have achieved the threshold;
 - (b) Classification marks within 0.5% of a higher classification will be awarded the higher classification.
 - (c) Module marks within 0.5% of a higher classification will be considered to have achieved the higher classification for the purposes of ascertaining whether a student's profile of marks has met the algorithm to be upgraded.

This rounding will be programmed into the progression and classification rules in the Student Record System.

Advantages:

- Marks recorded on the system would be the same as those reported to the student and Exam Board, improving direct reporting, auditing and historical records.
- Students would not be disadvantaged, so fairness and equity would continue.
- No manipulation of the data between recording on the system and display to the student/Exam Board, with the associated resource requirements.
- Keeping the same configuration as the current set up will simplify transitional arrangements and reporting.

Disadvantages:

- Although it is in the spirit of the previously-agreed principle of NAM, in that the stage and classification marks will be considered as integers at those boundaries where it matters, there may be some confusion and perceived discrepancy between the *result*, which will be based on the integer, and the *actual* recorded mark, which will be to two decimal places.
- Goes against a previously-agreed principle of NAM

2. Display two decimal places on all documentation to the student and Exam Board.

Advantages:

- Marks recorded on the system would be the same as those reported to the student and Exam Board, improving direct reporting, auditing and historical records.
- Students would be neither advantaged nor disadvantaged, so fairness and equity would continue.
- No manipulation of the data between recording on the system and display to the student/Exam Board, with the associated resource requirements.
- Keeping the same configuration as the current set up will simplify transitional arrangements and reporting.

Disadvantages:

- Goes against a previously-agreed principle of NAM

3. Display one decimal place on all documentation to the student and Exam Board.

Advantages:

- Previously agreed as a principle of NAM
- The scale of rounding would be less than if integers were used, so less students would be advantaged or disadvantaged
- Goes some way to accommodate those examiners who have previously expressed concerns about unnecessary and unhelpful precision that display of marks at 2DP entails.

Disadvantages:

- This would require data manipulation between what is stored on SITS and displayed to students and Exam Boards, which would require extra technical and administrative resource to implement and maintain and conflicts with another principle of NAM
- Marks recorded on the system would be different from those reported to the student and Exam Board and there is an associated risk in official reports displaying marks in a different configuration to that stored on the official system, especially over time regarding auditing and historical records.
- May lead to queries and appeals from students who are disadvantaged through accumulated loss of fraction of marks

4. Display integers on all documentation to the student and Exam Board.

Advantages:

- Accommodates those examiners who have previously expressed concerns about unnecessary and unhelpful precision that display of marks at 2DP entails.

Disadvantages:

- Goes against a previously-agreed principle of NAM
- This would require data manipulation between what is stored on SITS and displayed to students and Exam Boards, which would require extra technical and administrative resource to implement and maintain and conflicts with another principle of NAM
- Marks recorded on the system would be different from those reported to the student and Exam Board and there is an associated risk in official reports displaying marks in a different configuration to that stored on the official system, especially over time regarding auditing and historical records.

- May lead to queries and appeals from students who are disadvantaged through accumulated loss of fraction of marks
5. Display two decimal places on all documentation to the student, and either one decimal place or integers to the Exam Board.

Advantages:

- Accommodates those examiners who have previously expressed concerns about unnecessary and unhelpful precision that display of marks at 2DP entails.
- Would be in keeping with the previously-agreed principle of NAM

Disadvantages:

- This would require data manipulation between what is stored on SITS and displayed to Exam Boards, which would require extra technical and administrative resource to implement and maintain and conflicts with another principle of NAM
- Marks recorded on the system would be different from those reported to the Exam Board. Those Boards which would appreciate the extra precision of 2 DP would not be able to access this information
- May lead to queries and appeals from students who are disadvantaged through rounding down.

Recommendation:

To implement option (1), that Stage Average and Classification marks continue to be recorded and displayed in all reports to two decimal places and for the purposes of progression and classification, stage average and classification marks will be treated as integers.

Caroline Sauverin, Head LTS, Systems
13/6/13

APPENDIX

Mark Rounding

The following example illustrates the problem with using ‘rounded’ marks at any stage in the process of recording or reporting student marks. Any system of rounding creates injustices, because there will be some students for whom the rounding proves fortuitous and some for whom it does not. These injustices can become very dramatic indeed if rounding occurs at more than one stage in the process.

In the example we imagine two students on the same course, for which the profile is quite typical (under NAM). They take eight modules over years 2 and 3, each counting for 30 credits. Each module has four items of summative assessment: an exam (counting for 50% of the module) and three items of coursework (CW1-3, counting for 10%, 15% and 25%). Years 2 and 3 count, respectively, towards 40% and 60% of the final mark.

The students’ marks are shown in Figure 1. The profiles are similar, but insofar as there are slight differences Student 2 has quite consistently performed better than Student 1. Student 2’s Year 2 exam marks are better than those of Student 1, so are her Year 2 CW marks, so are her Year 3 exam marks, and so are her Year 3 CW marks. Student 2’s Year 2 average is better than that of Student 1, and so is her Year 3 average. Student 2 has obtained an average mark above 50 in most of her modules, while Student 1 has never done so.

Figure 1

<u>Student 1</u>					<u>Student 2</u>				
Year 2					Year 2				
	Module A	Module B	Module C	Module D		Module A	Module B	Module C	Module D
Exam [50%]	49	41	50	58	Exam [50%]	50	41	50	60
CW3 [25%]	48	59	49	42	CW3 [25%]	50	60	49	41
CW2 [15%]	48	57	49	40	CW2 [15%]	53	59	48	40
CW1 [10%]	48	57	49	40	CW1 [10%]	50	61	50	42
Module Mark	48.50	49.50	49.50	49.50	Module Mark	50.45	50.45	49.45	50.45
Year Average	49.25				Year Average	50.20			
Year 3					Year 3				
	Module E	Module F	Module G	Module H		Module E	Module F	Module G	Module H
Exam [50%]	50	59	48	49	Exam [50%]	50	60	48	50
CW3 [25%]	49	40	48	48	CW3 [25%]	50	41	49	49
CW2 [15%]	49	40	50	48	CW2 [15%]	53	40	48	48
CW1 [10%]	49	40	50	48	CW1 [10%]	50	42	50	50
Module Mark	49.50	49.50	48.50	48.50	Module Mark	50.45	50.45	48.45	49.45
Year Average	49.00				Year Average	49.70			
Overall Mark	49.10				Overall Mark	49.90			

In Figure 1, the Module Marks, Year Averages and the Overall Mark (which would be used for degree classification purposes, and visible also to prospective employers on a student’s HEAR) are calculated and shown, in line with our current practice, to two decimal places. Commensurate with his/her consistently better performances, Student 2 has the higher Overall Mark: 49.90 versus 49.10.

However, Figure 2 (below) shows what happens if (as per one present proposal), marks are rounded to the nearest integer, at two stages: for the purposes of reporting Module Marks and the Overall Mark.

Figure 2

Student 1					Student 2				
Year 2	Module A	Module B	Module C	Module D	Year 2	Module A	Module B	Module C	Module D
Exam [50%]	49	41	50	58	Exam [50%]	50	41	50	60
CW3 [25%]	48	59	49	42	CW3 [25%]	50	60	49	41
CW2 [15%]	48	57	49	40	CW2 [15%]	53	59	48	40
CW1 [10%]	48	57	49	40	CW1 [10%]	50	61	50	42
Module Mark	49	50	50	50	Module Mark	50	50	49	50
Year Average	49.75				Year Average	49.75			
Year 3	Module E	Module F	Module G	Module H	Year 3	Module E	Module F	Module G	Module H
Exam [50%]	50	59	48	49	Exam [50%]	50	60	48	50
CW3 [25%]	49	40	48	48	CW3 [25%]	50	41	49	49
CW2 [15%]	49	40	50	48	CW2 [15%]	53	40	48	48
CW1 [10%]	49	40	50	48	CW1 [10%]	50	42	50	50
Module Mark	50	50	49	49	Module Mark	50	50	48	49
Year Average	49.50				Year Average	49.25			
Overall Mark	50				Overall Mark	49			

The marks for all items of assessment remain the same in Figure 2 as in Figure 1 (and any objective assessment would again judge Student 2 to have performed consistently, slightly better). But the proposed rounding method happens to be fortuitous for Student 1 and not for Student 2.

Remarkably, this ‘good fortune’ *more than* offsets the actual difference in performance; so Student 1 attains an Overall Mark of 50 and Student 2 attains an Overall Mark of just 49.¹

My view is that this outcome is intolerable for any conscientious exam board. If the status quo were the method used in Figure 2, then we would be under a moral obligation to try, if resources allowed, to switch to the method used in Figure 1. Given that the status quo is the method in Figure 1, it absolutely does not make sense to switch deliberately (and perhaps even have to spend resources in doing so) to the method in Figure 2.

I would emphasise that the issue highlighted by this example is not particular to the specific rounding method that is currently proposed: *any* rounding method will inevitably lead to the same issue for some profiles. I therefore want to argue that the existing practice should instead be preserved.

Ben McQuillin (Chair of ECO UG Exam Board),
31st May 2013.

¹ It is worth noting that the reversal of ranking actually occurs even if the marks are only rounded for Module Mark purposes. In this case, rounding again for the purpose of reporting the Overall Mark merely exacerbates the problem.

Comments on rounding paper for TPPG 5 June & LTC 26 June 2013

Please note that these comments are based on the paper considered by TPPG, and that the 'recommendation (a)' referred to is 'recommendation (2)' in the LTC paper. 'Recommendation (1) in the current paper was not an option for consideration when the paper was circulated for comment.

Summary

Adrian Matthews, ENV	Original NAM principles (assessment/mod marks as integers and stage and award to 1 dp)
Shawn McGuire, DEV	Retain 2 dps throughout
Mary Jane Platt, MED	If rounding adopted, only do it at the end
Christina Riggs, ART	Retain 2 dps throughout
David Evans, MTH	Retain 2 dps throughout (with provision to allow a student with, eg, 39.95% to pass the module)
Jan Kaiser, ENV	Use of 'whole percentage points' throughout
Judy Barker, NSC	Retain 2 dps throughout
Katharina Huber, CMP	CMP unable to comment due to lack of time
Nigel Clayden, CHE	Content to retain 2dp; any rounding should only be at the end

Adrian Matthews, ENV: I would be in favour of integer marks for modules, and single decimal place for aggregate marks. If these can be incorporated into this year's paperwork, all the better. If not, we will use our discretion and common sense as always.

Shawn McGuire, DEV: After quickly reviewing the discussion paper, I tend to agree with its conclusions – that it makes the most sense to continue with current practice of recording all marks (module, and stage / year) to two decimal places. This is just my own personal view – DEV's Undergraduate Teaching Director (Ed Anderson) and Exam Board Chair (Rob Grant) may wish to offer a different view to feed into the TPPG discussions.

Mary Jane Platt, MED: This is quite complex, especially as in MED we record everything Pass/Fail! However, as I understand it, the fundamental principles of arithmetic are that you keep the DPs etc. to the last possible moment, then reduce. So unless we are being explicit as to why we are rounding earlier, the rounding should only take place at the very last stage in the calculations.

Christina Riggs, ART: In response to the email Elizabeth circulated this week, with the document for discussion about rounding of marks: Margit (chair of examiners) and I (as teaching director) are strongly in agreement with Caroline's recommendations for option 'a' in each case - i.e., to keep the current system of recording and calculating all marks to two decimal places.

As the paper from ECO clearly demonstrates, rounding up marks, at any stage, risks disadvantaging or advantaging some students, and in the former case leaves the university open to an increased number of appeals. Moving to integers would be extremely detrimental to the quality of marking and assessment at UEA, casting doubt on the calibre of our degree results.

Moreover, the current system clearly has the benefit of working on a technical level, relieving our colleagues in LTS from having to expend considerable time and effort massaging data in various unnecessary and unhelpful ways. It now appears that the integer proposal should not have been included in the NAM to begin with - and perhaps would not have been had the systems implications been investigated thoroughly in advance.

Some American adages make sense on this side of the pond, too: If it ain't broke, don't fix it!

David Evans, MTH: Some comments on this on behalf of MTH.

Our view is that option (a) in both cases is the right thing to do.

That said, we note that one of the reasons for the NAM idea of working with integers was to avoid the absurdity of a student having to go to reassessment or even failing a module (and therefore possibly being thrown off a degree) with a mark of 39.95. This problem still remains under this proposal. It would be good to identify some mechanism -- other than an appeal -- for handling such a situation.

Jan Kaiser, ENV: As one of the Exam Board Chairs who have expressed a preference to report all marks rounded to the nearest percentage point, I do not think that the TPPG discussion paper addresses the needs of students, employers and exam boards and does not appraise the underlying valid reasons for the desire to move to rounded marks within the New Academic Model. Many of the arguments are based on technical limitations, which are self-imposed and which I am not happy to accept. My detailed comments are outlined below, including suggestions how to find an alternative solution. Please table this paper at today's TPPG meeting.

- The underlying problem is the non-continuous nature of the degree classification system. If a minor difference of marks couldn't drastically change future career prospects (and league tables), there would probably be no discussion. Clearly, that's nothing UEA can resolve on its own, so a solution is needed that does not make this problem worse.
- Using self-imposed software limitations as an argument for one rounding method or another cannot be in the interests of students and UEA (and the image employers and examiners get of UEA's administrative skill and efficiency). Likewise, the argument that maintaining the status quo is easier than change should not feed into the decision. If necessary, SITS needs to be reprogrammed, not the degree regulations rewritten.
- It is important to bear in mind the degree of uncertainty associated with any mark. A marking scale in 1 %-steps from 0 to 100 % is extremely fine-grained and probably exaggerates the precision of the marking. A further sub-division into fractions of 1 % is even less credible.
- Reporting assessment item or module average results with a precision greater than 1 % to students, employers or examiners therefore does not appear to be statistically sound. Since module marks are reported on degree transcripts/HEAR, they should be rounded to whole percentage points. Reporting marks with a precision greater than 1 % would project an untenable degree of confidence into our ability to discriminate between the performance of students.
- The document prepared for TPPG discussion on 5 June 2013 barely mentions this, but it is important to reiterate that reporting marks in 1 % steps is borne out by the desire of both examiners and employers (and probably also students). In other words, this stated and previously-agreed principle of NAM has not been added "on a whim", but for genuine reasons and needs.

- A degree classification decision based on fractions smaller than 1 % does not appear to be sound either. For example, a student with a reported degree average mark of 57.99 % and 160 credits or a student with a classification mark of 58.00 %, 100 credits above 60.00 % and 20 credits at 59.99 % may not be awarded a 2:2, whereas a student with a classification mark of 58.00 % and 120 credits at 2:1 or above would be awarded a 2:1. Of course, any threshold is problematic and a boundary has to be set somewhere. However, these boundaries would be at 57.49 % and 59.49 % in the examples above, which would actually (in 1 % steps) be reported as 57 % and 59 %.
- It may be argued that the precision of a mark increases the more individual marks feed into it. For example, one might think that the average classification mark has higher precision than individual module marks. However, this assumes all module marks "measure" the same "quantity", which they don't (students don't write 12 exams of the same kind). Rather, the uncertainty of the classification mark will be similar to the uncertainty associated with each module mark (assumed, perhaps too optimistically, to be 1 %).
- Dr McQuillin (ECO Exam Board Chair) nicely illustrates that it is impossible to discriminate between the performance of two students whose classification marks are within 1 % if the underlying module marks have an uncertainty of 1 % (or more).
- Statistically, there is no advantage or disadvantage to students whether marks are rounded or not. It is just a matter of accepting the calculation method. Rounding is an accepted practice in law, finance, science etc., so there does not appear to be anything against it in principle.
- Arithmetic rounding (i.e. rounding up from 0.5 to the next integer) introduces a small positive bias for numbers reported with a limited number of decimals. For example, rounding numbers with two decimals leads to an average positive bias of 0.005. However, as long as the machine precision of the computer is retained, this bias is negligible.
- Ideally, the full precision of individual data feeding into the rounded value should be retained. At an individual student level, repeated rounding can indeed change classification marks by more than 0.5 %, as pointed out Dr McQuillin.
- This leads to a conflict with the desire to report rounded module marks on transcripts and to exam board because if the classification mark calculated from rounded module marks will differ from the same mark calculated from the unrounded module marks.
- Reporting rounded module marks should be the overriding principle for at least two reasons
 - employers find module marks reported to fractions of 1 % not credible
 - For classification decisions on borderline candidates we need to know which module marks are above 50, 60 or 70 to apply the "120 credit above boundary" rule. Doing this at the 0.01 % level do not appear to be sound.
- It would be best to store the unrounded marks, but report them rounded, but this would lead to inconsistencies between what is reported and what is stored.
- Since it was deemed to be important that marks shown on reports and stored on SITS are identical [and I am not sure I accept this argument], the full precision module marks cannot be used for calculating classification marks. Therefore, we need to know what the maximum disadvantage is to a student when using repeatedly rounded marks. I believe this is at most (and not including) 1 %, but it may be less (I haven't worked this out rigorously).
- So, to avoid disadvantaging students, I'd propose that classification marks should always be rounded up, e.g. a mark of 69.00001 % would be rounded up to 70 % (and reported as 70 %). A mark of 69 % exactly would stand. UCL applies this method already. This would extend the borderline range to nearly 3 %, since a classification mark of 67.000001 % would be reported as 68 %. On paper, the cut-off between two classifications would be separated by 1 % (although the mathematical difference

could be tiny, but that goes back to the underlying problem of having a non-continuous classification scale).

- A similar rounding up should occur for reporting stage average marks. However, the current SITS implementation of calculating average classification marks based on weighting module averages (rather than stage averages) should be retained to avoid compounding rounding-up errors.
- An alternative to the above proposal would be to restrict the number of assessment items per module (something UEA aims to achieve anyway). If there were only one mark feeding into each module mark (reported to whole percentage points), rounding module marks would not be an issue. If there were two items weighted 50:50 and arithmetic rounding was used, the student could only benefit from rounding up (module average marks would either end with .0 or .5).
- It is incorrect to refer to marks such as 59 %, as "integer marks". 59 % actually represents the number 0.59, which is not an integer. Either the percent symbols is dropped or "integer" should be replaced by "whole percentage point".

So, in summary, I suggest that module and assessment item marks are rounded arithmetically to the nearest whole percentage point. Year average and classifications marks are calculated from the weighted average module marks and then rounded up. Rounded marks are reported to exam boards, students and on transcripts.

Alternatively, full precision marks should be retained at all steps and stored on SITS, but reported on HEAR and to exam boards after arithmetic rounding to whole percentage points. This would mean that marks reported on HEAR and to exam boards are different to those stored on SITS, but I don't think this is a problem. Students could always access the full precision data on SITS (and may be given a separate transcript showing these data when they leave UEA) if they wanted to verify the calculations.

Judy Barker, NSC: In NSC we have considered the paper regarding the above and agree with the recommendations to implement options (a) therefore keeping the two decimal places.

Katarina Huber, CMP: Thank you very much for your invitation to comment on the rounding problem of student results within the context of NAM. We feel that the situation we are facing is not satisfactory but at the same time do not have enough time to comment on this matter any further due to the short notification that we have been given.

Nigel Clayden, CHE:

1. A fundamental principle in any calculation is that rounding is only carried out at the final step, so in this case when a student aggregate mark is calculated. If this is not adhered to the maximum rounding error would be 6 (120 credits at least 20 credits modules) x 0.49 marks = +/- 2.94 marks per year. Though a case such as this would be highly unusual.

2. Always rounding up from a 5 introduces a bias - in analytical chemistry you round to an even number so 57.5 rounds up to 58 but 56.5 would round down to 56.0 but then I don't think the students would be happy with this!

Marks are then submitted as integers.

All intermediate calculations store the 2 decimal places of SITS Final aggregate mark given as integers.

Anything other than integer marks implies a precision in the mark which just isn't there.

Again in science the number of significant figures reflects the precision of the measurement.

I doubt any mark is more precise than +/- 1.