

Supporting students with a weak mathematical background during their first trimester of University study using Numbas

Anthony Brown

University College Dublin

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- The Leaving Certificate is the Irish equivalent to A Levels.
- They are considered to be equivalent to A Levels, but usually seven subjects are taken, with the best six counting towards the points required for admission to University.
- There are two levels; Ordinary and Higher.
- Higher level count for substantially more University admission points.
- 25 bonus points are awarded for higher level mathematics at grades H6 and above.

Leaving Certificate Grades



Grades	% Marks
H1 / O1	90 - 100
H2 / O2	80 < 90
H3 / O3	70 < 80
H4 / O4	60 < 70
H5 / O5	50 < 60
H6 / O6	40 < 50
H7 / O7	30 < 40
H8 / O8	0 < 30

Leaving Certificate Points



Higher		Ordinary	
GRADE	POINTS	GRADE	POINTS
H1	100		
H2	88		
H3	77		
H4	66		
H5	56	O1	56
H6	46	O2	46
H7	37	O3	37
H8	0	O4	28
		O5	20
		O6	12
		O7	0
		O8	0

- Two modules, MATH00010 and MST00050, with essentially the same syllabus. MATH00010 caters for 'Science' students and MST00050 caters for 'Arts' students.
- The minimum maths requirement for admission to many degrees at UCD is O6/H7.
- So students on these modules may have obtained a mathematics mark as low as 30% in higher level, or 40% in ordinary level.

- The idea is to give students a solid foundation in basic mathematics, so that they will be able to successfully study mathematics at degree level. The syllabus is:
 - Fractions
 - Exponents
 - Roots
 - Addition and subtraction of algebraic expressions
 - Multiplication and division of algebraic expressions
 - Solving equations and finding roots
 - Lines and their equations
 - Matrices
 - Quadratic graphs and their equations
 - The exponential and logarithm functions
 - Differentiation
 - Integration

Implementation of the Modules



- The main focus is to get students to do lots and lots of practice questions.
- The hope is that if we accomplish this, then the students will both be able to pass the exam easily and also be well prepared for future study.
- Numbas is ideal as a tool due to the randomisation, and crucially the feedback that you can give, tailored to the question.
- Each week, starting in the second week, students have to complete several Numbas exams, and also attend an in class written test.
- The mark allocation is 15% for the Numbas exams, 25% for the class tests, and 60% for the final two hour exam.

- The Numbas exams were originally allocated 25% and the final exam 50%, this was changed since there was concern from the School that too many marks were allocated for the continuous assessment. However it is my experience that if we get the students to do enough practice, then they will have no problem with the exam.
- Numbas exams are integrated into the 'Brightspace' VLE for the modules, and all the marking and calculation of the final grades is done automatically, once the Gradebook has been set up.

Numbas Exams: A View from the Student Side



[My Learning](#) [Assessment ▾](#) [Discussions](#) [My Class ▾](#) [Library ▾](#) [Module Tools ▾](#)

Bookmarks

Module Schedule

Learning Materials

129

Important Course Information

✓

Course Notes

11

Numbas Exams

35

Set 1 Numbas Exams
Ends 8 October

3

Set 2 Numbas Exams
Ends 15 October

3

Set 1 Numbas Exams ▾

Print

Due 08 October 2021 9:00 PM

Ends 08 October 2021 9:00 PM

These exams should be completed by 9pm on Friday October 8th.

0 % 0 of 3 topics complete

Adding and Subtracting Fractions ▾

Content Object

Due 08 October 2021 9:00 PM

Ends 08 October 2021 9:00 PM

Multiplying and Dividing Fractions ▾

Content Object

Due 08 October 2021 9:00 PM

Ends 08 October 2021 9:00 PM

Finding the Least Common Multiple ▾

Content Object

Due 08 October 2021 9:00 PM

Ends 08 October 2021 9:00 PM

Numbas Exams: A View from the Student Side



Finding the Least Common Multiple ▾



NUMBAS

Finding the least common multiple

Question 1	10 marks Unanswered
Question 2	10 marks Unanswered
Question 3	10 marks Unanswered
Question 4	16 marks Unanswered
Question 5	16 marks Unanswered

Display options

Find the least common multiple of the numbers 90 and 375 by first stating how many copies of each prime they have when expressed as a product of primes.

If a particular prime does not appear in a product then the answer should be entered as 0.

An example of a correct answer would be:

60 has copies of 2, copies of 3 and copies of 5

and

81 has copies of 2, copies of 3 and copies of 5.

Thus $\text{lcm}(60, 81)$ has copies of 2, copies of 3 and copies of 5.

Hence $\text{lcm}(60, 81) =$.

90 has copies of 2, copies of 3 and copies of 5.

and

375 has copies of 2, copies of 3 and copies of 5.

Thus $\text{lcm}(90, 375)$ has copies of 2, copies of 3 and copies of 5.

Hence $\text{lcm}(90, 375) =$.

Numbas Exams: A View from the Student Side



NUMBAS

Finding the least common multiple

Question 1	10 marks Unanswered
Question 2	10 marks Unanswered
Question 3	Score: 0/10 Unanswered
Question 4	16 marks Unanswered
Question 5	16 marks Unanswered

Display options

Advice

90 has copies of 2, copies of 3 and copies of 5.

and

375 has copies of 2, copies of 3 and copies of 5.

Taking the maximum number of copies for each prime, we see that $\text{lcm}(90, 375)$ has copies of 2, copies of 3 and copies of 5.

Hence $\text{lcm}(90, 375) =$.

Score: 0/10

Score: 0/10 ✖

Unanswered

Created using [Numbas](#), developed by [Newcastle University](#).

Finding the least common multiple

Click on a question number to see how your answers were marked and, where available, full solutions.

Question Number	Score	
Question 1	0 / 10	Review
Question 2	0 / 10	Review
Question 3	0 / 10	Review
Question 4	0 / 16	Review
Question 5	0 / 16	Review
Total	0 / 62 (0%)	

Performance Summary

Exam Name:

Finding the least common
multiple

Session ID:

14041871515

Numbas Exams: A View from the Student Side



Final Calculated Grade

Points

0 / 40

Grade Item	Points	Grade
Set 1 Numbas Exams		
Adding and Subtracting Fractions	0 / 40	0 %
Multiplying and Dividing Fractions	0 / 32	0 %
Finding the Least Common Multiple	0 / 62	0 %
Set 2 Numbas Exams		
Calculating Powers (Whole Number Bases and Non-Negative Exponents)	0 / 8	0 %
Calculating Powers (Whole Number Bases and Negative Exponents)	0 / 7	0 %
Rules of Indices with Numerical Bases	0 / 12	0 %

Numbas Exams: A View from the Student Side



- The Numbas exams are not timed but do have to be completed by 9pm on Friday each week.
- They can be attempted as many times as the student wants to.
- The mark awarded is the the mark in the last attempt, so each time a student enters an exam, the mark is reset to zero.
- If a student is happy with the grade they have got in a particular exam, but feels that they would still like more practice, there are a second set of Numbas exams where the marks do not count towards the final grade. These are particularly important during the revision period.

- Although they are a lot of work, the students are very enthusiastic about Numbas. This did slightly surprise me, when I wrote the course, I was worried about a lot negative feedback due to the Numbas exams being so much work. Here are some comments from students:
- 'The numbas exams are extremely helpful'.
- 'The numbas exams were extremely helpful in keeping the work fresh in my mind.'
- 'Online "Numbas" exam helped me learn so much in an efficient manner.'
- 'the numbas exams were a pain to do but they were really helpful for learning the course work.'

Numbas Exams: A View from the Lecturer Side



- The Numbas exams are a lot of work to write and setup at the start, but once this has been done, they are worth their weight in gold.
- There are occasional technical problems, which lead to some emails from students, but these are not very many, considering that over 100 students take one or other of the modules. I would only get an average of about five emails per week. These generally seem to come from students who are working from home with a poor internet connection.
- If the worst comes to the worst, the exam in question can be 'zero rated', but this is a very rare occurrence due to technical problems, it is much more common due to student illness, especially this year with Covid.

Numbas Exams: A View from the Lecturer Side



Using Gradebook in Brightspace, you can see the marks each student obtained on each exam.

Last Name ▲, First Name, Username	Final Grades	☐ Set 1 Numbas Exams ▼		
	Final Calculated Grade ▼	Adding and Subtracting Fractions ▼	Multiplying and Dividing Fractions ▼	Finding the Least Common Multiple ▼
	35.864 / 40 ⓘ	39 / 40, 97.5 %	31 / 32, 96.875 %	61 / 62, 98.387 %
	24.761 / 40 ⓘ	40 / 40, 100 %	32 / 32, 100 %	59 / 62, 95.161 %
	12.399 / 40 ⓘ	40 / 40, 100 %	32 / 32, 100 %	52 / 62, 83.871 %
	30.648 / 40 ⓘ	40 / 40, 100 %	32 / 32, 100 %	62 / 62, 100 %
	19.338 / 40 ⓘ	38 / 40, 95 %	32 / 32, 100 %	61 / 62, 98.387 %
	21.096 / 40 ⓘ	40 / 40, 100 %	32 / 32, 100 %	51 / 62, 82.258 %
	9.189 / 40 ⓘ	39 / 40, 97.5 %	24 / 32, 75 %	62 / 62, 100 %
	24.232 / 40 ⓘ	40 / 40, 100 %	32 / 32, 100 %	62 / 62, 100 %
	0 / 40 ⓘ	0* / 40, 0 %	0* / 32, 0 %	0* / 62, 0 %

Numbas Exams: A View from the Lecturer Side



As well as the mark, the amount of time each student spent on each Numbas exam, and how many times they visited it can be seen. This is part of the report for the Finding the Least Common Multiple Exam:

<input type="checkbox"/>	Last Name ▲, First Name	Available	Last Visited	Number of Visits	Total Time Spent	Average Time Spent
<input type="checkbox"/>		Yes	07 October 2021	8	0:37:17	0:18:38 ?
<input type="checkbox"/>		Yes	05 October 2021	2	0:17:50	0:17:50 ?
<input type="checkbox"/>		Yes	08 October 2021	2	0:16:20	0:16:20 ?
<input type="checkbox"/>		Yes	05 October 2021	4	0:37:38	0:18:49 ?
<input type="checkbox"/>		Yes	08 October 2021	4	0:35:43	0:17:51 ?
<input type="checkbox"/>		Yes	01 October 2021	2	0:22:25	0:22:25 ?
<input type="checkbox"/>		Yes	08 October 2021	2	-	- ?
<input type="checkbox"/>		Yes	30 September 2021	4	0:16:23	0:08:11 ?

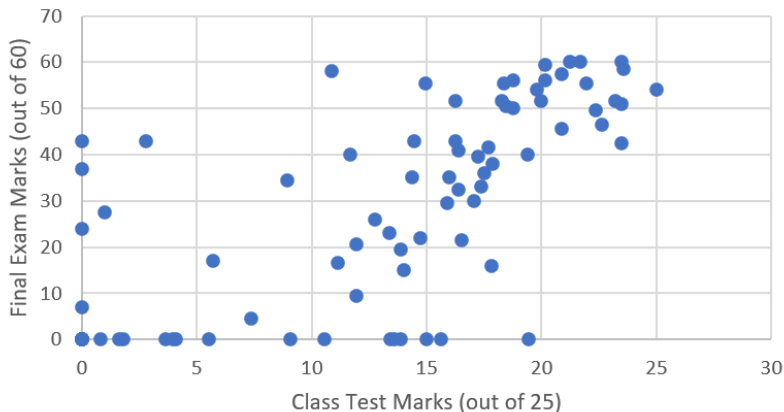
Unfortunately, there is a problem with Brightspace 'System Time Outs', and this is why the average time does not tally with the total time and number of visits.

- Of course, the most important question is, does it work?
- The answer is a resounding yes!
- Even though this cohort of students did poorly in their leaving certificate exam, over 60% of the students obtained over 60% in the final exam, and this in an exam which was substantially more difficult.
- In the following slides, we will compare the Numbas and class test results with the final exam results. It turns out that in both cases there is a pretty strong correlation.

The Outcome

In MATH00010, the correlation between the final exam marks and the class test marks was $r \simeq 0.69$.

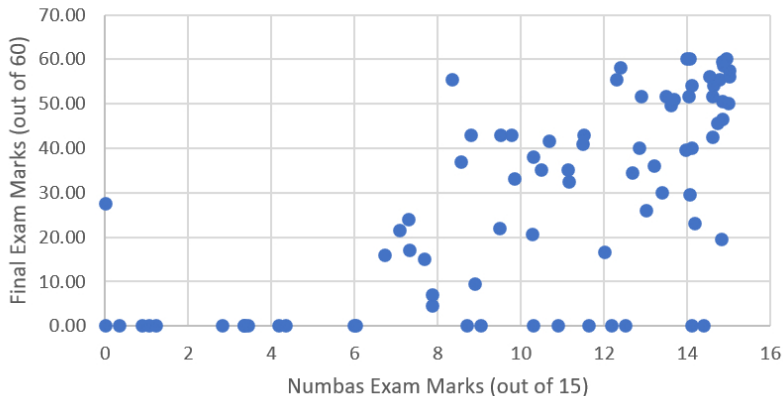
Final Exam Marks Versus Class Test Marks



The Outcome

In MATH00010, the correlation between the final exam marks and the Numbas exam marks was $r \simeq 0.67$.

Final Exam Marks Versus Numbas Exam Marks



- Using the data from Brightspace, I think it would be interesting to see if there is any correlation between the amount of work a student puts in on the 'Numbas Exams for Practice' (that is the ones that do not have to be completed) and the final exam mark.
- Of course it may be that there is a negative correlation, since they might more often be taken by students who realise they are struggling.
- As you can see on the following slides, there is a lot of data to drill down into.

Numbas Exams for Practice Data



This shows the number of students who have visited each set of exams, and the average time spent.

▶ i. Set 1 Numbas Exams for Practice	87	56	0:18:48
▶ ii. Set 2 Numbas Exams for Practice	87	49	0:09:43
▶ iii. Set 3 Numbas Exams for Practice	87	45	0:20:23
▶ iv. Set 4 Numbas Exams for Practice	87	37	0:14:29
▶ v. Set 5 Numbas Exams for Practice	87	41	0:22:37
▶ vi. Set 6 Numbas Exams for Practice	87	37	0:28:01
▶ vii. Set 7 Numbas Exams for Practice	87	39	0:21:01
▶ viii. Set 8 Numbas Exams for Practice	87	34	0:12:08
▶ ix. Set 9 Numbas Exams for Practice	87	33	0:14:51
▶ x. Set 10 Numbas Exams for Practice	87	30	0:32:43

Numbas Exams for Practice Data



Drilling down into Set 10, we can see the equivalent data for each of the exams.

▼ x. Set 10 Numbas Exams for Practice	87	30	0:32:43
I. Finding Global Maxima and Minima	87	26	0:44:25
II. Finding and Classifying Extreme Points	87	22	0:30:29
III. Percentage Changes	87	22	0:21:25

Numbas Exams for Practice Data



Drilling down further, we can see the data for individual students. Unfortunately this is where the problem with 'System Time Outs' occurs, but I suspect that if we multiply the average time spent by the number of visits, we would get a reasonably accurate estimate of the total time spent.'

Last Name ▲ , First Name	Available	Last Visited	Number of Visits	Total Time Spent	Average Time Spent
	Yes	09 December 2021	18	0:29:11	0:03:14 ?
	Yes	-	-	-	-
	Yes	-	-	-	-
	Yes	-	-	-	-
	Yes	13 December 2021	2	0:01:29	0:01:29 ?
	Yes	14 December 2021	10	0:23:50	0:04:46 ?
	Yes	02 December 2021	2	0:00:05	0:00:05 ?
	Yes	-	-	-	-