

# Trends in Basic Mathematical Competencies of Beginning Undergraduates in Ireland, 2003-2014

Presented by: Dr Páraic Treacy

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## Project Maths linked to decline in performance, says study

**JOE HUFFMEYERS**  
Education Correspondent

Students entering third level are at increased risk of failing exams with a maths module, according to a study that casts doubt on the merits of the new Leaving Cert maths syllabus.

Researchers at University of Limerick found the mathemati-

cal ability of students entering higher education declined significantly in the period 2003-2005, and say the focus on doing practical exercises in Project Maths at the expense of "drilling" students in basic skills could be a contributing factor.

Conversely, the study also indicates that the standard

of maths associated with a B at higher level in the Leaving Cert corresponds roughly with a C 10 years ago, and similarly that a C corresponds to a D.

This year was the first in which all Leaving Cert and Junior Cert students followed the Project Maths syllabus.

The study, published this month in the *International*

*Journal of Mathematical Education in Science and Technology*, analysed the performance of students beginning science and technology-based undergraduate courses in the US.

Researchers Finis Freney of US's department of mathematics and DIT academic Fiona Faulkner discovered that 12 per cent of students who achieved a

higher-level grade C in the Leaving Cert in 2003 were at risk of failing their third-level exams. This compared with just 1.8 per cent in 2005.

More than 40 per cent of those who achieved a higher level of grade D in 2003 were at risk of failure at third level compared with 12 per cent in 2005. Similar patterns were

identified at lower grades.

The authors say the findings indicate that the transition to Project Maths "has coincided with a decline in performance of the basic mathematical skills which are required for students to be fully prepared for service mathematics studied in higher education".

Dr Freney told *The Irish*

*Times* there could be factors other than Project Maths behind the trend but it was legitimate to ask whether "over-generous marks" were being given to students for attempting the higher paper.

**Relief as last week's frustration fades away**  
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**Exam Watch**  
Leaving Cert Irish and maths, Junior Cert maths, study tips and the student diary

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# The 'Maths Problem'

- Deficiencies in beginning undergraduate students' basic mathematical skills has been an issue of concern in higher education, particularly in the past 15 years<sup>1-4</sup>.
- The 'Maths Problem' reported in UK, Ireland, Australia and the U.S<sup>1-3</sup>.

<sup>1</sup> Lawson (2003); <sup>2</sup>O'Donoghue (2004); <sup>3</sup>Gill et al. (2010); <sup>4</sup>Faulkner (2012)

# Student Background

- Vast majority (>99%) of secondary level students in Ireland study mathematics at higher, ordinary, or foundation level for the Leaving Certificate.
- Students need to pass mathematics at higher or ordinary level to gain place on Technology based or Science based undergraduate courses at the University of Limerick (UL).

# Project Maths



Project Maths, gradually introduced between 2010 and 2012, aims to:

- encourage a greater focus on problem-solving skills while aligning assessment with these revised classroom practices<sup>5,6</sup>;
- place greater emphasis on student understanding of mathematical concepts with increased use of contexts and applications of mathematics in real world scenarios<sup>5,6</sup>.

<sup>5</sup>National Council for Curriculum and Assessment (2008);

<sup>6</sup>Department of Education and Skills (2010).

# Bonus Points

- Bonus points introduced for Leaving Certificate Mathematics Examinations in 2012.
- Students are awarded 25 bonus points if they achieve a grade D3 or better in their Leaving Certificate Higher Level Mathematics examination.

<b>Grade</b>	<b>Points</b>	<b>Grade</b>	<b>Points</b>
<b>HA1</b>	100	<b>OA1</b>	60
<b>HA2</b>	90	<b>OA2</b>	50
<b>HB1</b>	85	<b>OB1</b>	45
<b>HB2</b>	80	<b>OB2</b>	40
<b>HB3</b>	75	<b>OB3</b>	35
<b>HC1</b>	70	<b>OC1</b>	30
<b>HC2</b>	65	<b>OC2</b>	25
<b>HC3</b>	60	<b>OC3</b>	20
<b>HD1</b>	55	<b>OD1</b>	15
<b>HD2</b>	50	<b>OD2</b>	10
<b>HD3</b>	45	<b>OD3</b>	5

# Student Background

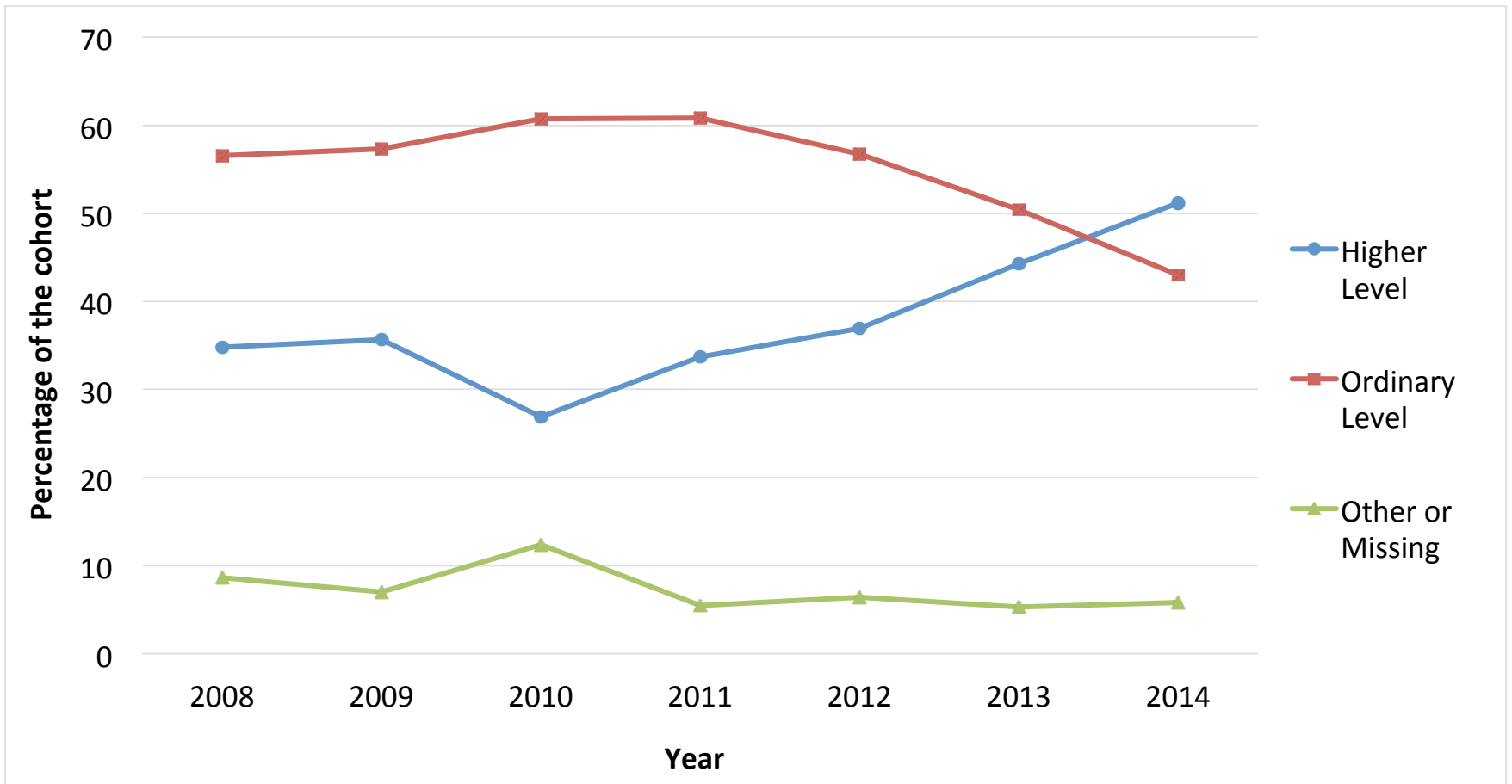


Figure: Proportion of students entering UL service mathematics modules from Leaving Certificate Higher Level, Leaving Certificate Ordinary Level or other (2008-2014).

# Diagnostic Test

- Students beginning their Science based and Technology based undergraduate courses at the University of Limerick (UL) have had their basic mathematics skills tested through a 40 question diagnostic test during their initial service mathematics lecture since 1998.
- Students who score 18/40 or less are considered 'at risk' of failing their service mathematics module.



# Diagnostic Test Questions

10. If  $x = 10^2$  then write down the value of  $\log x$

Ans \_\_\_\_\_ Don't know

11. If  $\log x = 5$  then write down the value of  $\log(x^2)$

Ans \_\_\_\_\_ Don't know

12. Express 0.01234 in Scientific Notations

Ans \_\_\_\_\_ Don't know

13. Divide 30 in the ratio 3 : 2

Ans \_\_\_\_\_ Don't know

## Algebra Q.14 - Q.21

14. Solve for  $h$  :  $V = \pi r^2 h$

Ans \_\_\_\_\_ Don't know

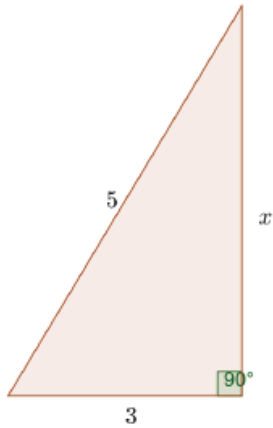
15. Evaluate  $ab + 2bc - 3ac$  when  $a = 3$ ,  $b = -2$  and  $c = 4$ .

Ans \_\_\_\_\_ Don't know

Rough Work

# Diagnostic Test Questions

25. Calculate the length of side  $x$ .

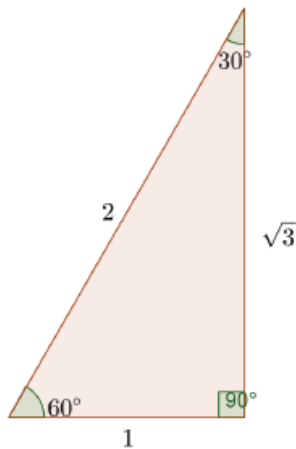


Ans \_\_\_\_\_

Don't know

## Trigonometry Q.26 - Q.28

26. Write down  $\sin 30^\circ$  as a fraction

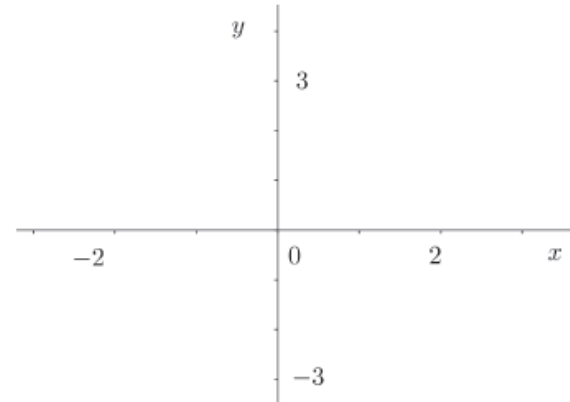


Ans \_\_\_\_\_

Don't know

## Coordinate Geometry Q.29 - Q.32

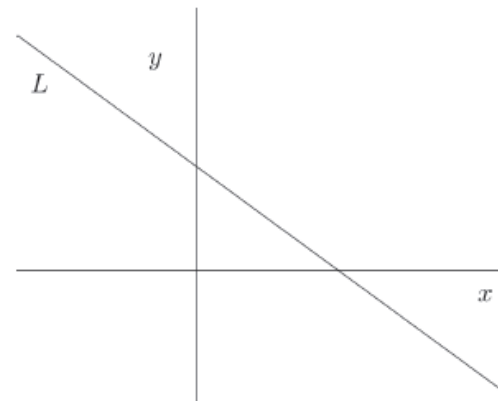
29. Locate the point  $B(3, -2)$  on the diagram



Ans \_\_\_\_\_

Don't know

30. State whether the line  $L$  has a positive or negative slope.



Ans \_\_\_\_\_

Don't know

# % of 'At Risk' Students

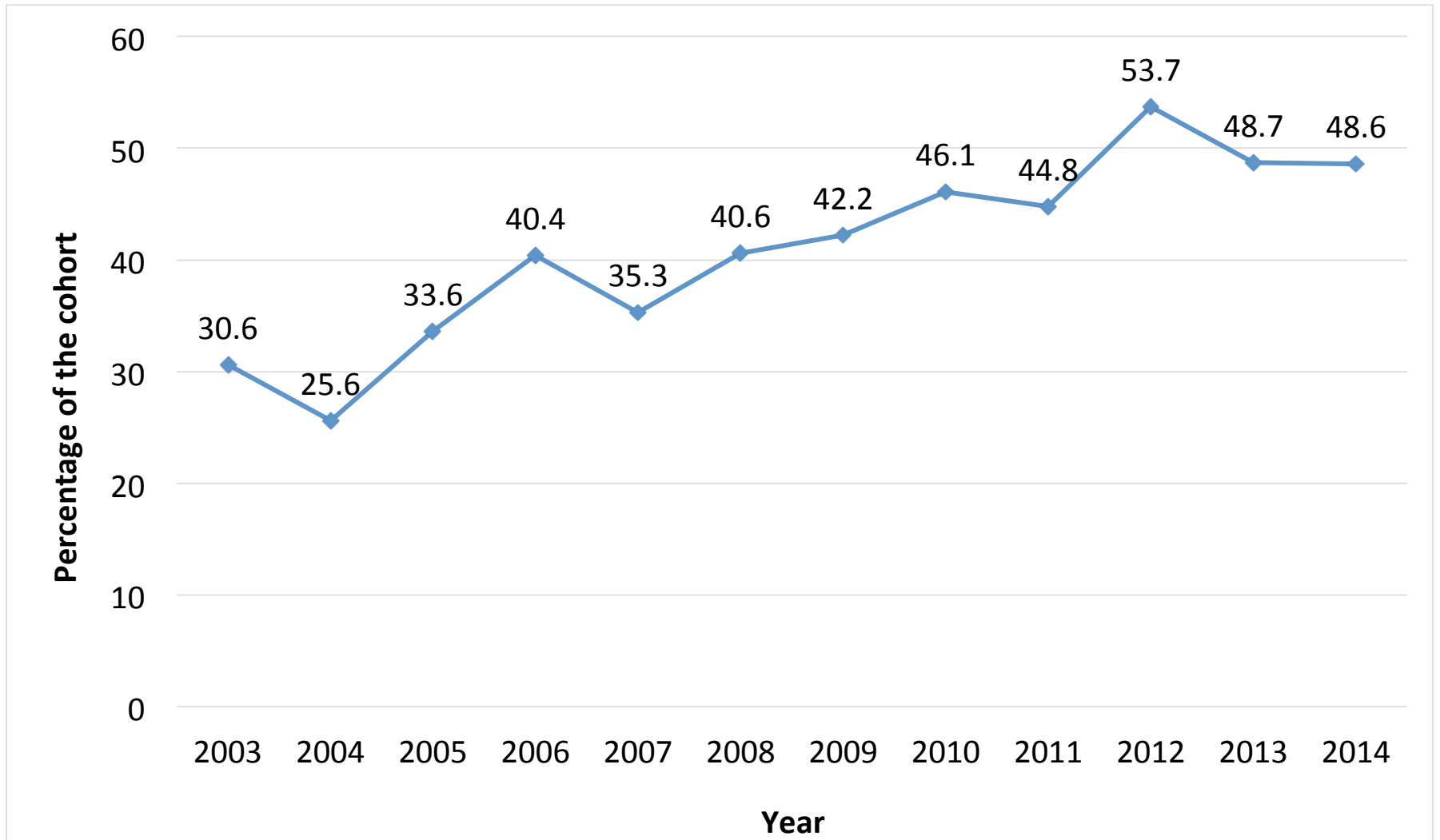


Figure: Percentage of yearly cohort that scored 18/40 or less in the UL diagnostic test

# 2003 v 2014: Performance in Diagnostic Test

Year	Mean	N	Std. Dev.
2003	22.03	337	6.573
2004	22.67	406	6.574
2005	21.25	497	6.739
2006	20.13	626	7.091
2007	21.15	580	6.982
2008	20.27	544	7.053
2009	20.15	682	7.443
2010	19.44	644	7.008
2011	19.84	686	6.963
2012	18.32	739	6.451
2013	19.05	645	6.376
2014	18.91	633	6.379

# 2003 v 2014: Performance in LC

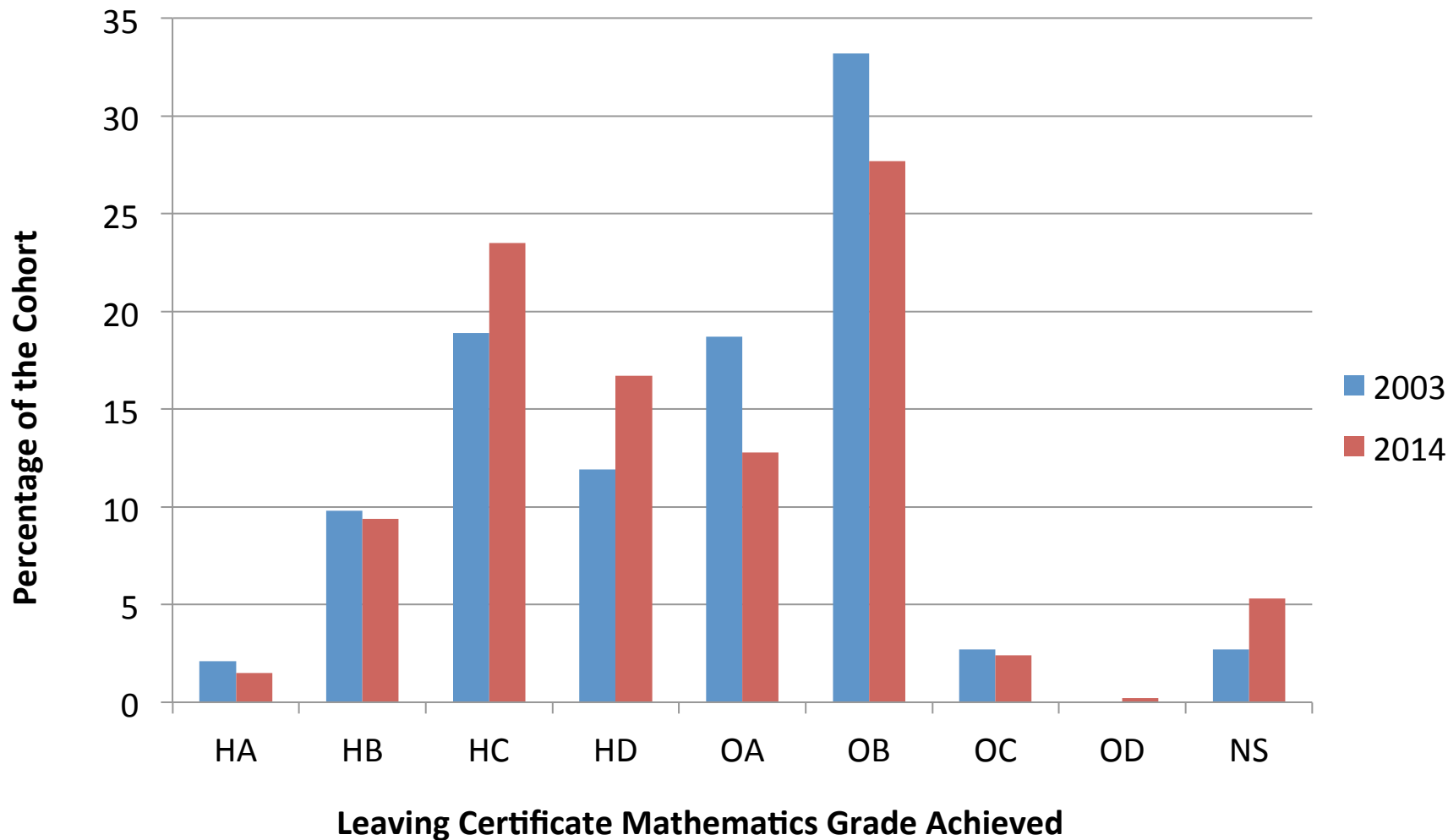
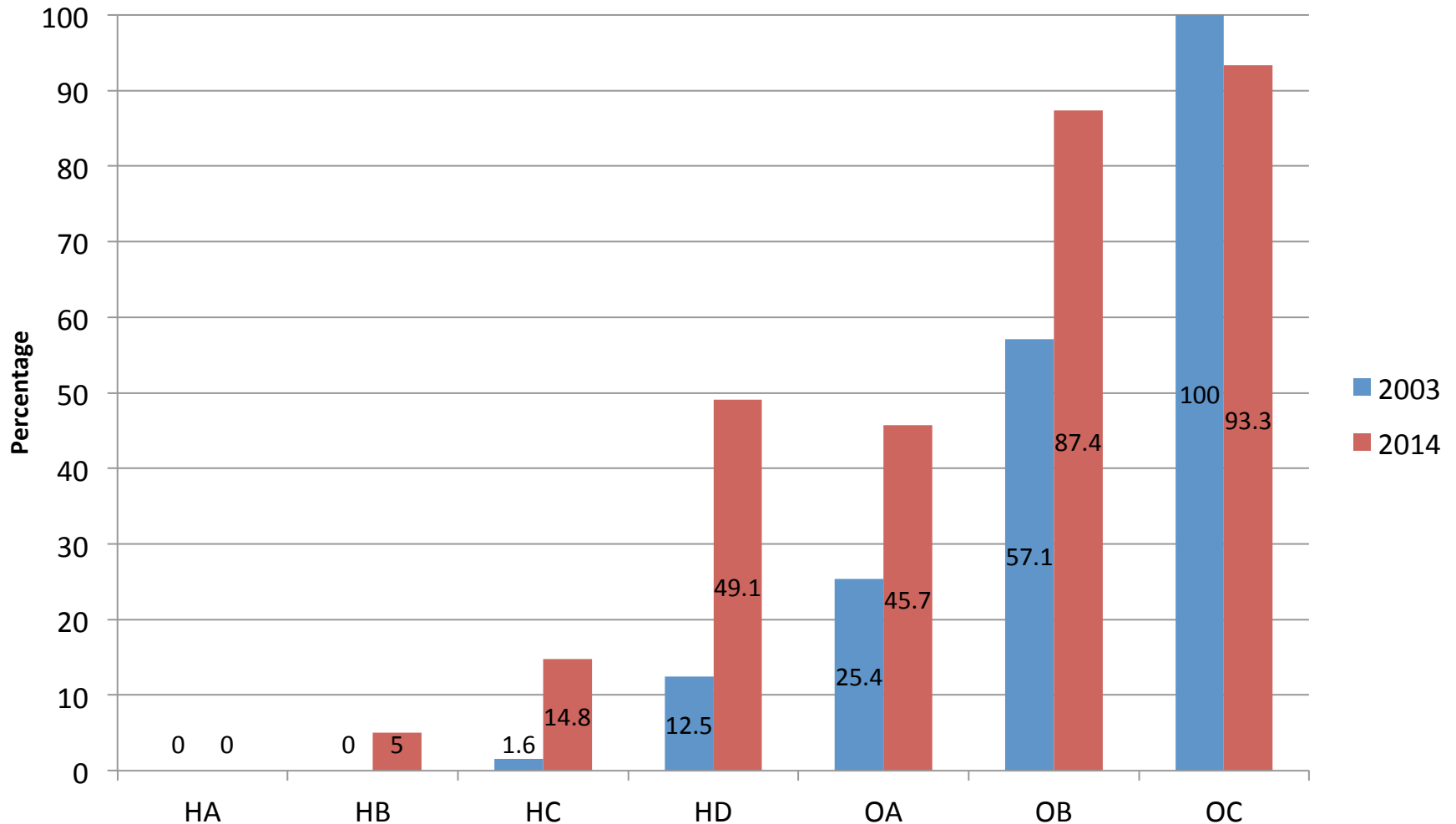


Figure: Proportion of Leaving Certificate grades achieved by students entering UL service mathematics modules in 2003 and 2014.

# 2003 v 2014: 'At Risk'



Percentage of students that achieved a given Leaving Certificate mathematics grade who were deemed to be 'at risk' in 2003 and 2014.

# Consistency

- Faulkner et al. (2010) found that students entering UL with particular leaving certificate mathematics grades performed to a similar level in the diagnostic test between 1998 and 2008.
- The same consistency was not present when comparing years in which bonus points/Project Maths were introduced into the Leaving Certificate examinations.

# Mean Score by LC Grade

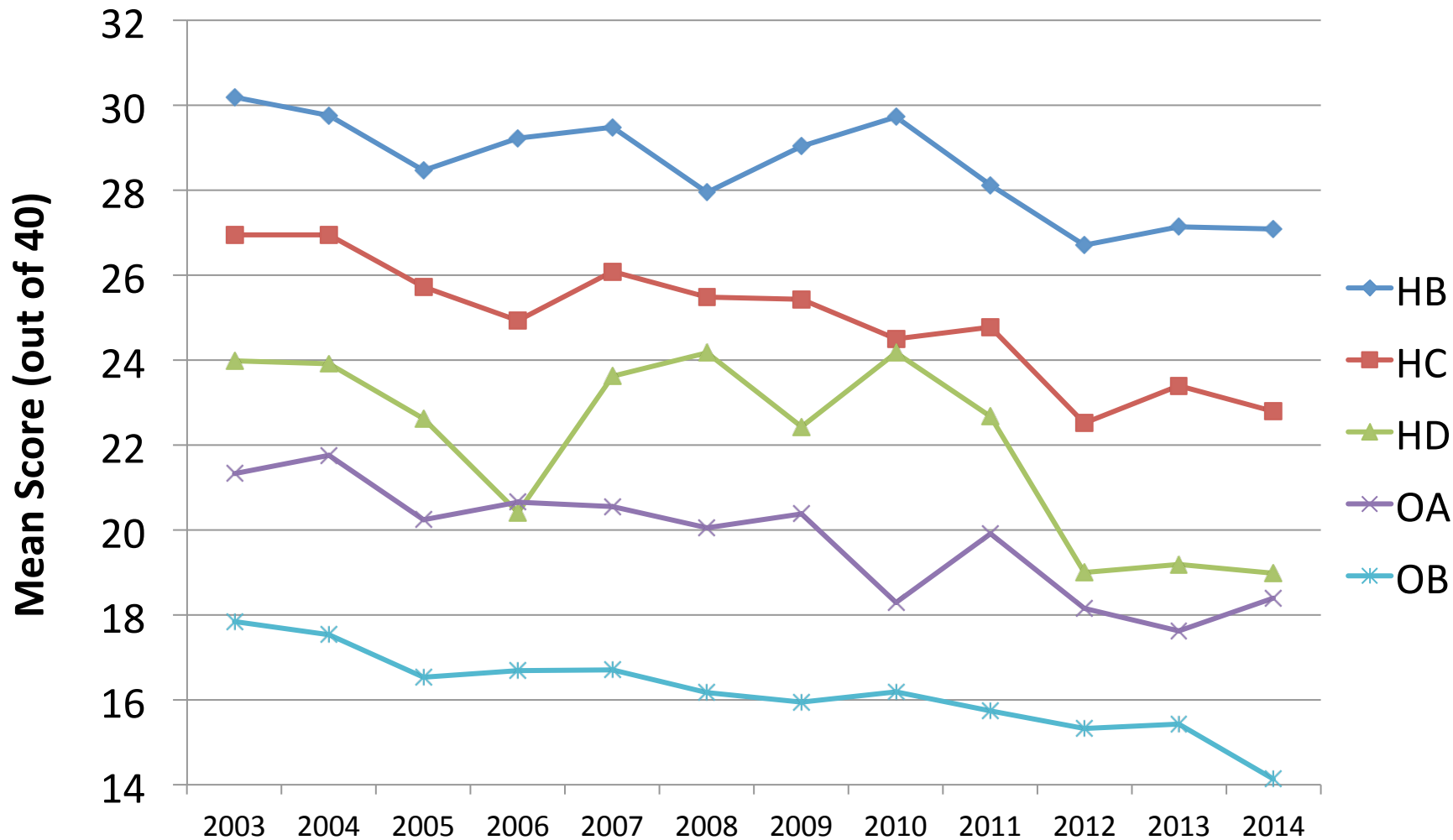


Figure: Mean score in the diagnostic test of students that achieved a given Leaving Certificate mathematics grade between 2003 and 2014.



# Conclusions

- The proportion of students predicted to be at risk of failing their service mathematics end-of-semester examinations has increased significantly between 2003 and 2014.
- Since the introduction of the Project Maths Curriculum and bonus points, significant declines in beginning undergraduates' performance of basic mathematical skills are evident, particularly among students who have achieved Higher Level C grades and Higher Level D grades.
- Is grade dilution an emerging issue?

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