

Enhancing the mathematical education  
of undergraduates:  
  
the role of **sigma**  
and the mathematics support community

Prof. Tony Croft  
Mathematics Education Centre  
Loughborough University

## Overview and background

### *"The mathematics problem"*

- *Measuring* the mathematics problem – the extent of the challenges facing UK mathematics education
- *Tackling* the mathematics problem
- The role of **sigma** – *network for excellence in mathematics and statistics support*

services and facilities offered by **mathcentre**, **sigma**, **stats**tutor and institutional support centres.

## The “mathematics problem”

- Anecdotally
- Quantitative Data
- Evidence from Government, Professional Body, and Research Reports

## The “mathematics problem” : anecdotal evidence

The screenshot shows the Manchester Evening News website. The main headline is "'Cool Cash' card confusion" by Ciara Leeming, dated November 03, 2007. Below the headline is a sub-headline: "A LOTTERY scratchcard has been withdrawn from sale by Camelot - because players couldn't understand it." There is also a paragraph: "The Cool Cash game - launched on Monday - was taken cut of shops yesterday after some players failed to grasp whether or nct they had won." An image of a Cool Cash Lotto ticket is shown, featuring a penguin character and the text "COOL CASH", "PRIZE", "PRIZE", "PRIZE", "PRIZE", and "WIN UP TO £5,000".

*On one of my cards it said I had to find temperatures lower than -8. The numbers I uncovered were -6 and -7 so I thought I had won, and so did the woman in the shop. But when she scanned the card the machine said I hadn't.*

*I phoned Camelot and they fobbed me off with some story that -6 is higher - not lower - than -8 but I'm not having it.*

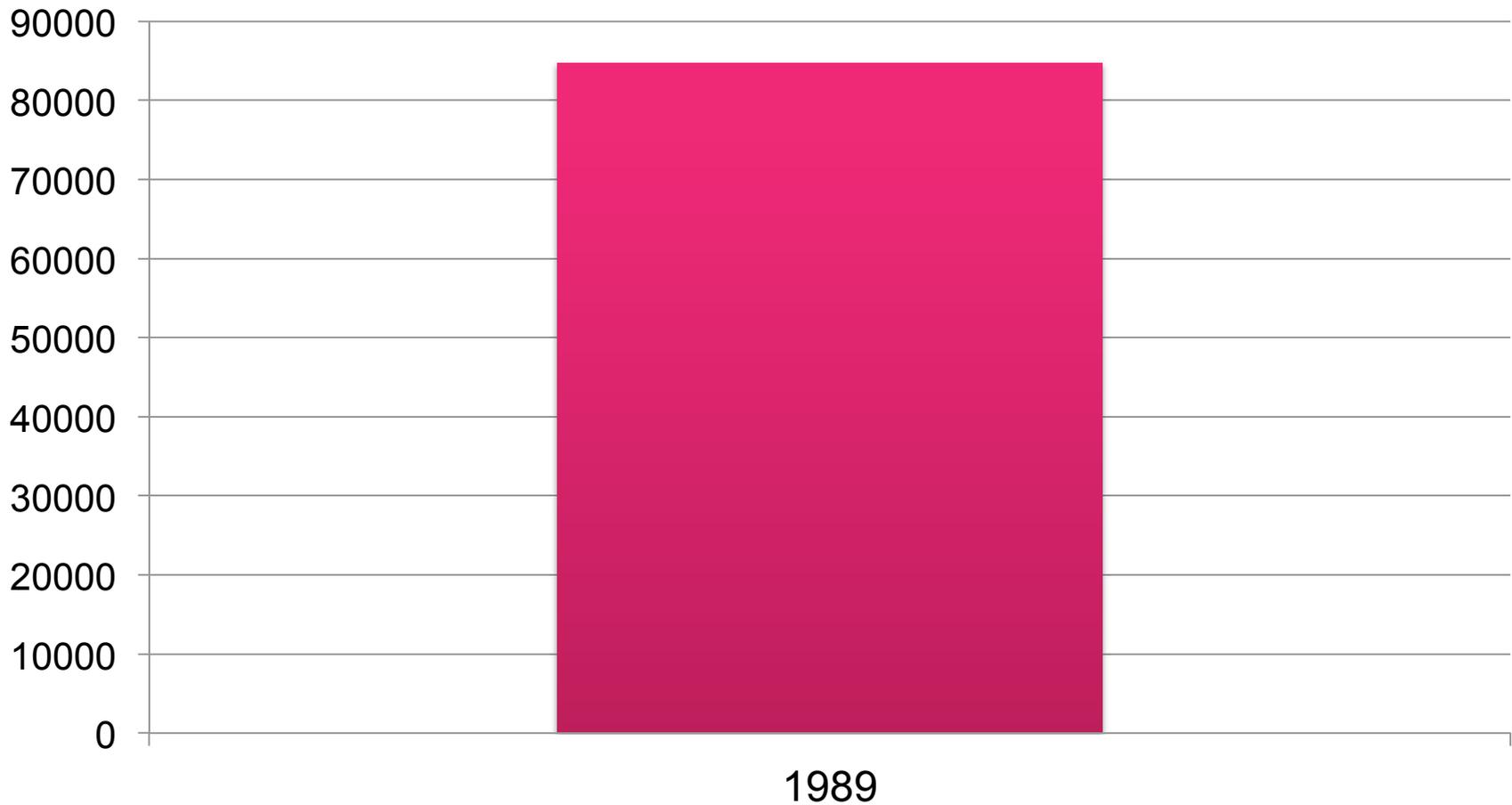
*Tina Farrell (23) - Levenshulme*

## National numeracy: across the UK 2012

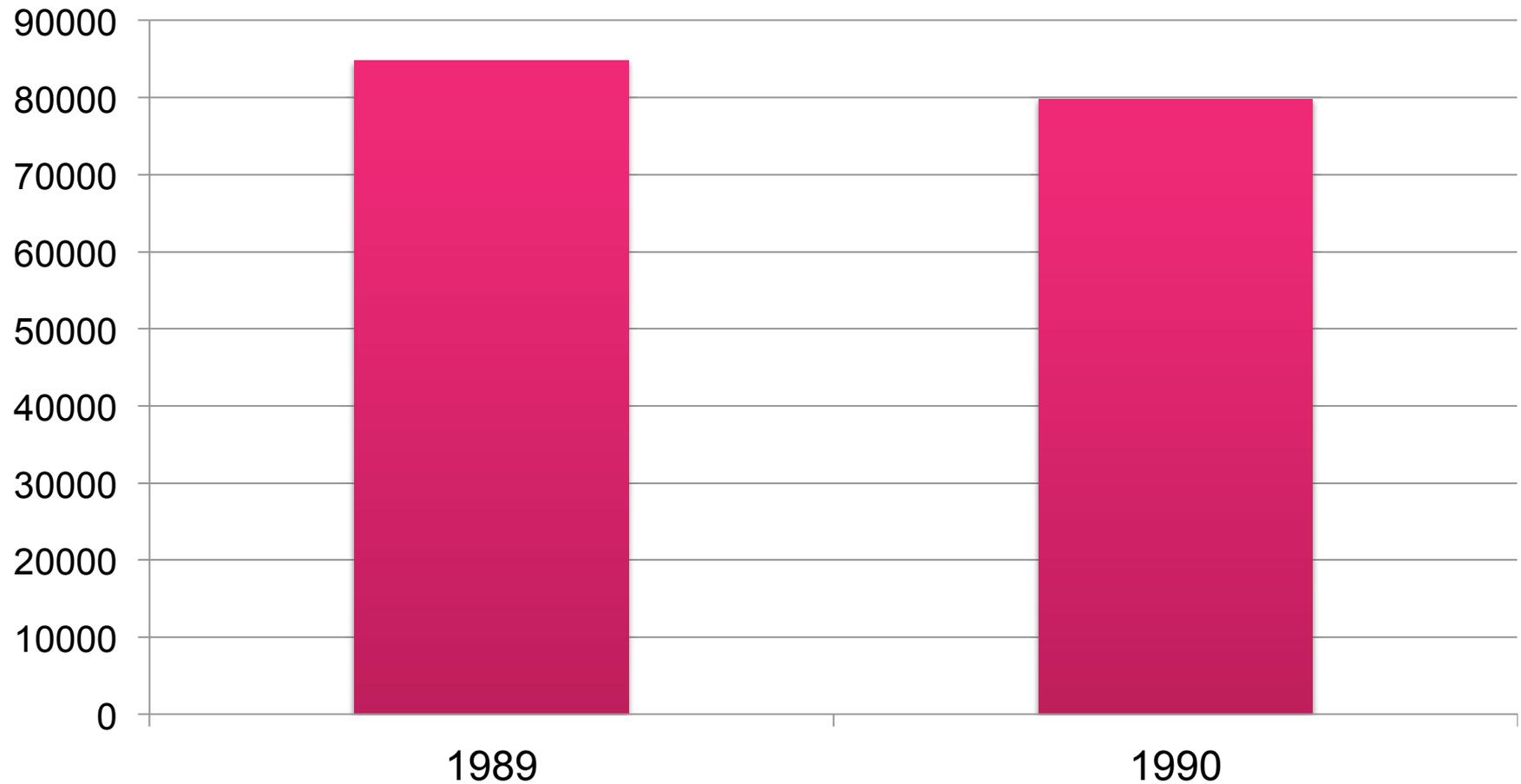
- **Around 4 in 5 adults** have a low level of numeracy - roughly defined as the adult skills equivalent of being below GCSE grade C level.
- In 2011, the Skills for Life Survey showed that **numeracy skills in England declined** in the 8 years from 2003, whereas literacy improved.
- These findings led to the realisation that 17 million adults in England are working at a level roughly equivalent to that expected of children at primary school.
- Around **30% of the people who rated their skills as “very good” performed poorly** - showing a sizable lack of awareness of this problem.

National Numeracy <http://www.nationalnumeracy.org.uk/news/16/index.html>

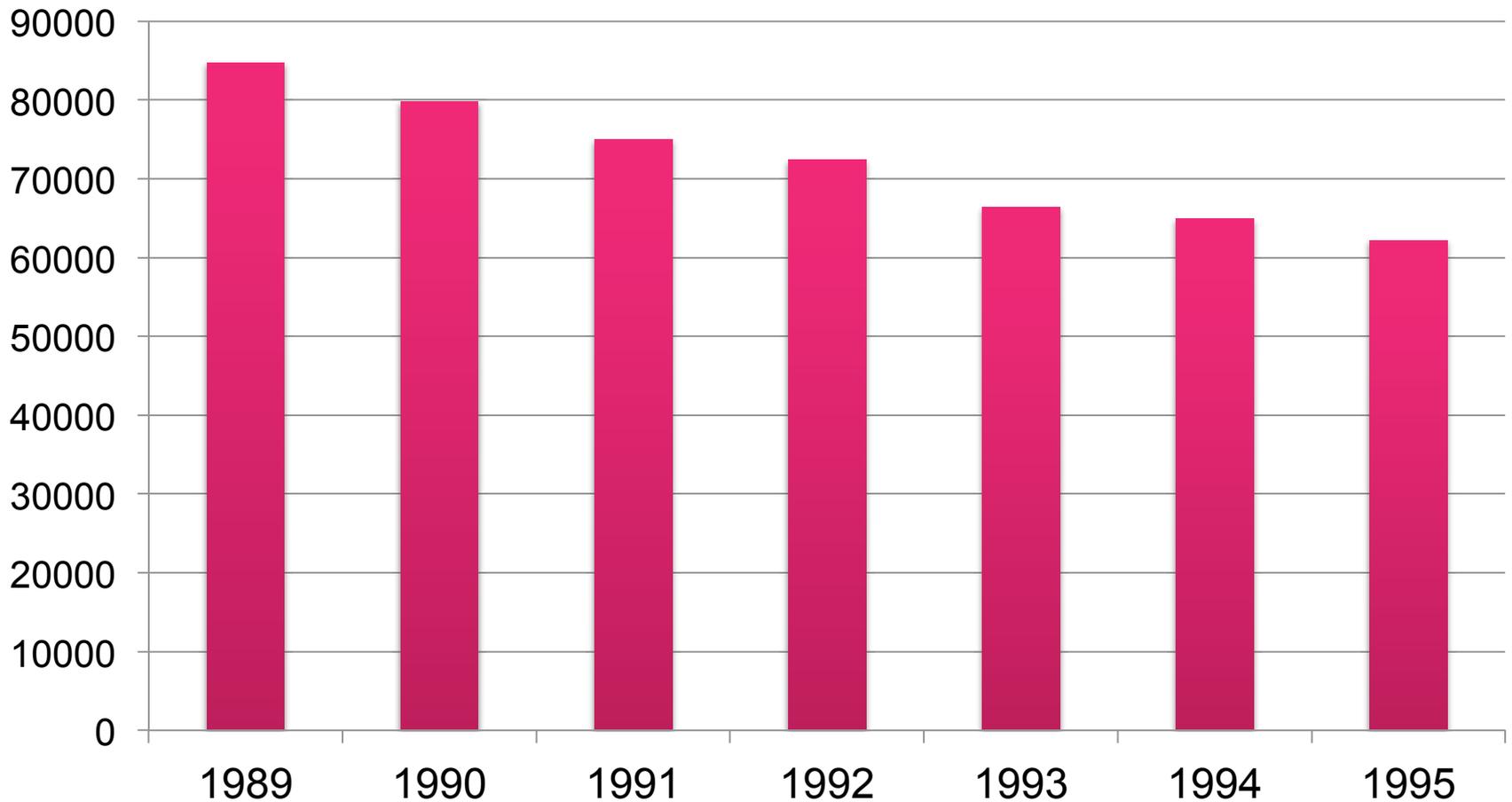
## Total Mathematics and Further Mathematics A level entries



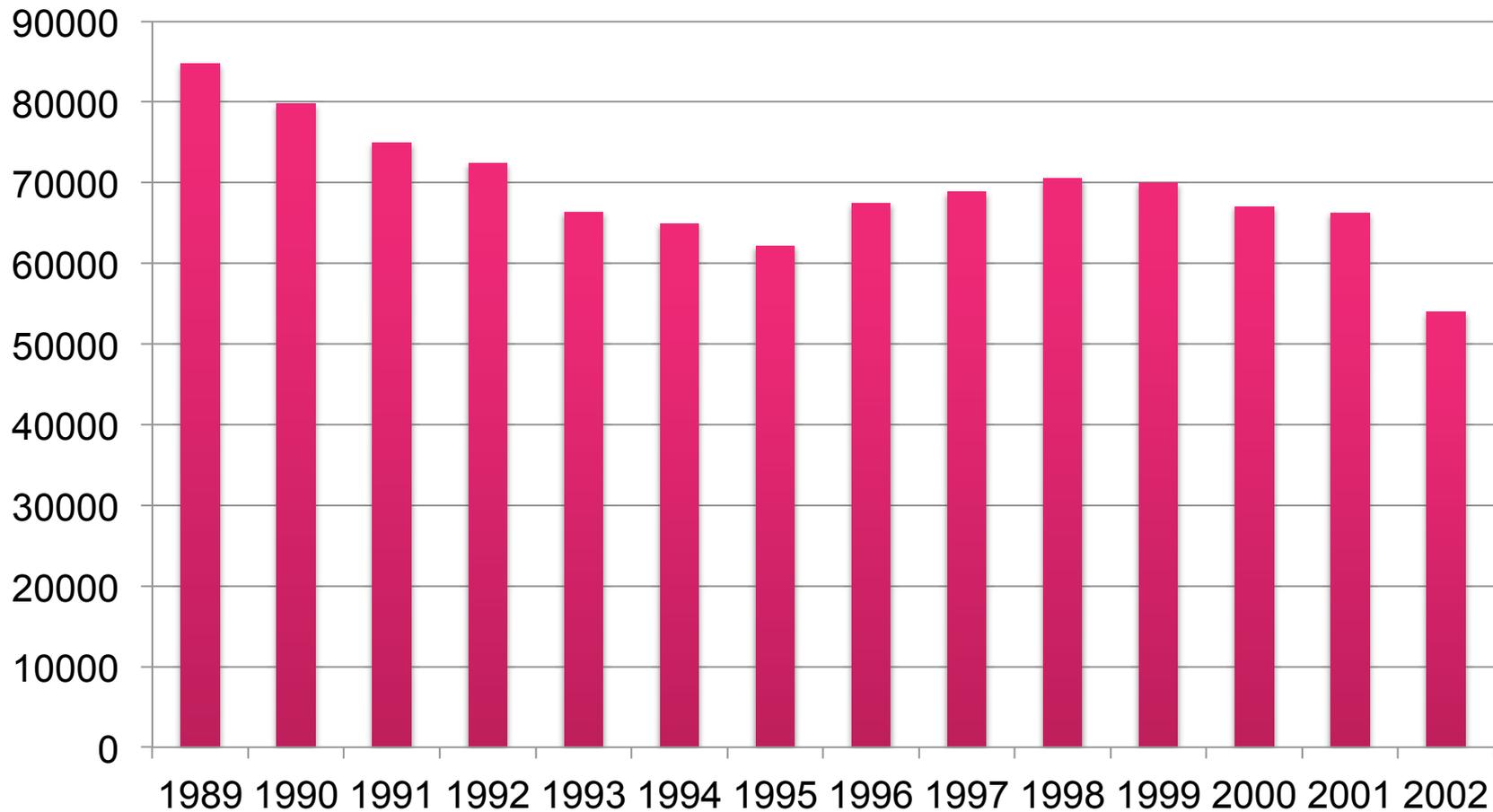
## Total Mathematics and Further Mathematics A level entries



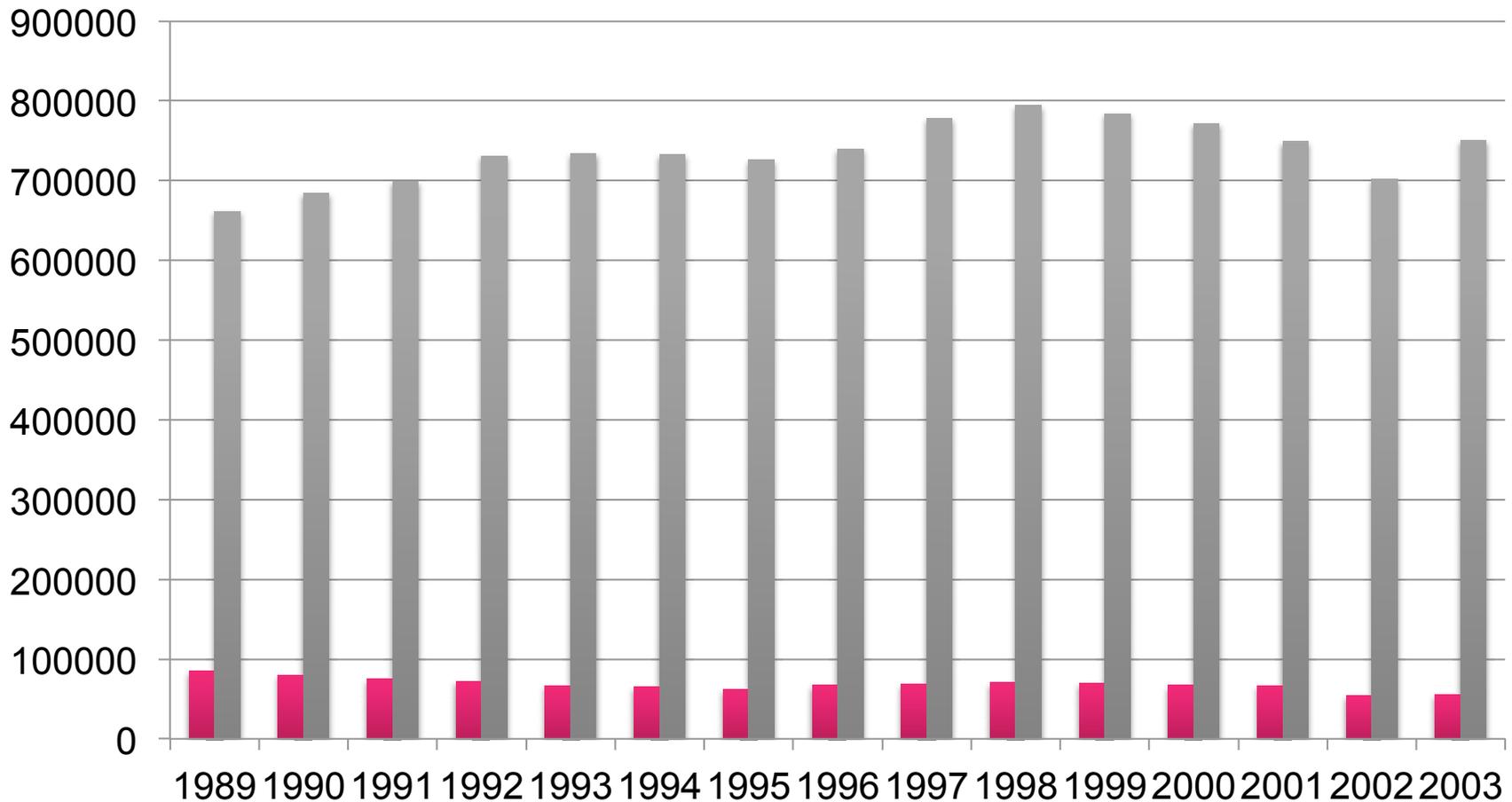
## Total Mathematics and Further Mathematics A level entries



## Total Mathematics and Further Mathematics A level entries

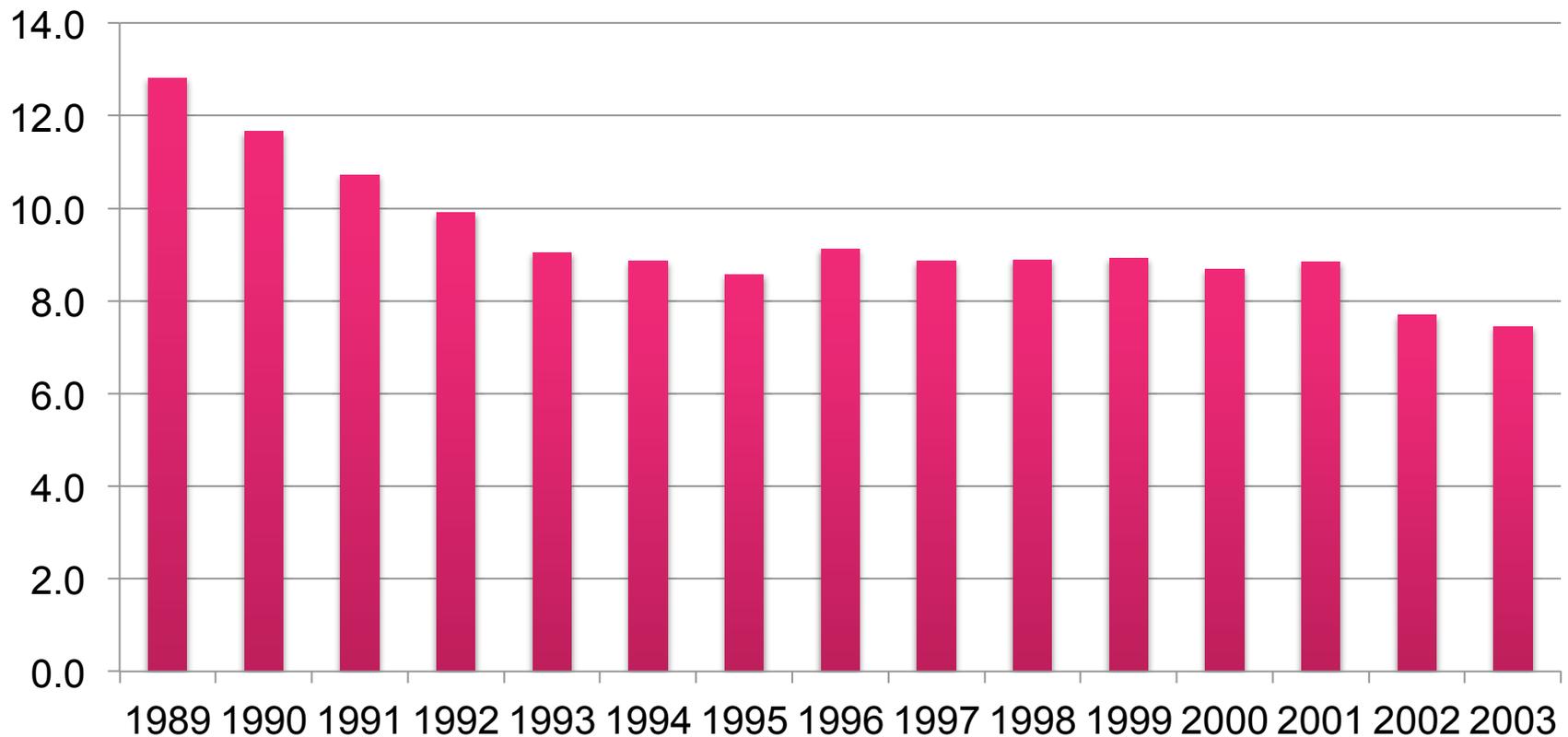


## Total A level entries compared with Maths & FM entries



## Maths & FM as % of total entries

### Maths & FM as % of total entries



# Confidence testing and diagnostic testing

*Learning Needs in Mathematics* 67

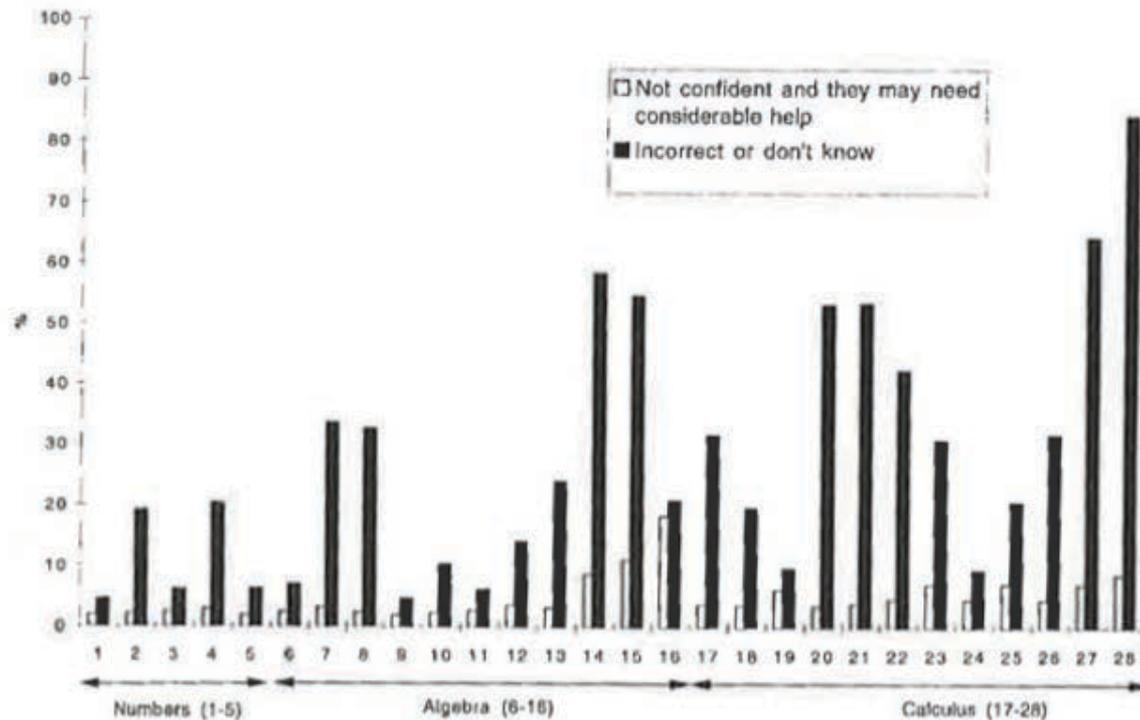


FIG. 12. Comparison of the 1997 Diagnostic Test and the Confidence Survey.

## Confidence testing and diagnostic testing

- 1995,1996,1997 Confidence Surveys, Diagnostic Testing

1997: N=557 (478  $\geq$  D in A level maths (86%))

- Simple quadratic equation which will factorize easily

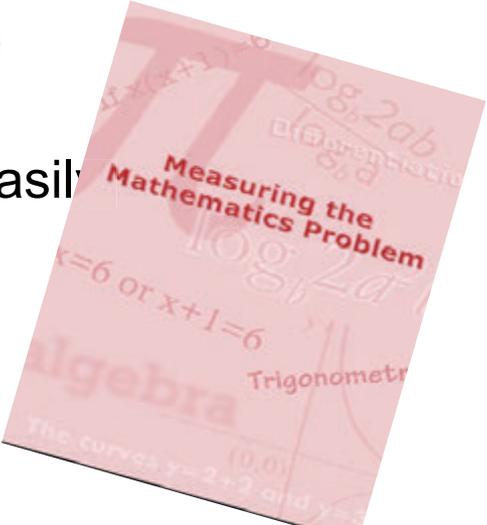
20% incorrect; 4% don't know

- Quadratic equation requiring use of the formula

7% incorrect; 31% don't know

- Simple partial fractions

22% incorrect; 37% don't know



***“Over 60 departments of physics engineering and mathematics are now routinely carrying out diagnostic mathematics tests”***

# The “mathematics problem” – a plethora of reports

## Making Mathematics Count

The report of Professor Adrian Smith's Inquiry into Post-14 Mathematics Education

February 2004



## RESPONDING TO THE MATHEMATICS PROBLEM: The Implementation of Institutional Support Mechanisms



Edited by C. M. Marr and M. J. Greve

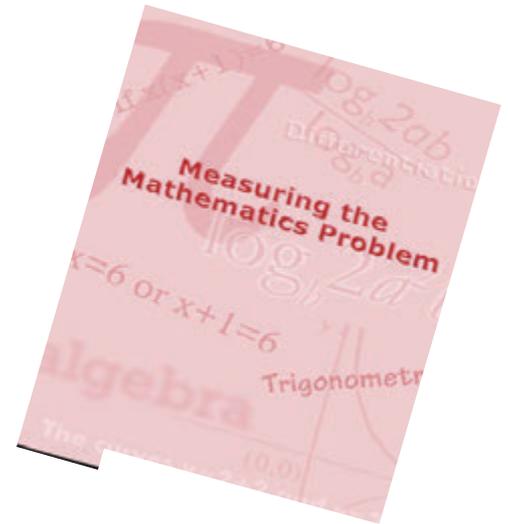
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Staying the course: The retention of students in higher education

REPORT OF THE COMMISSIONER AND AUDIT OF THE COMMISSIONER'S INVESTIGATION INTO THE MATHEMATICS PROBLEM

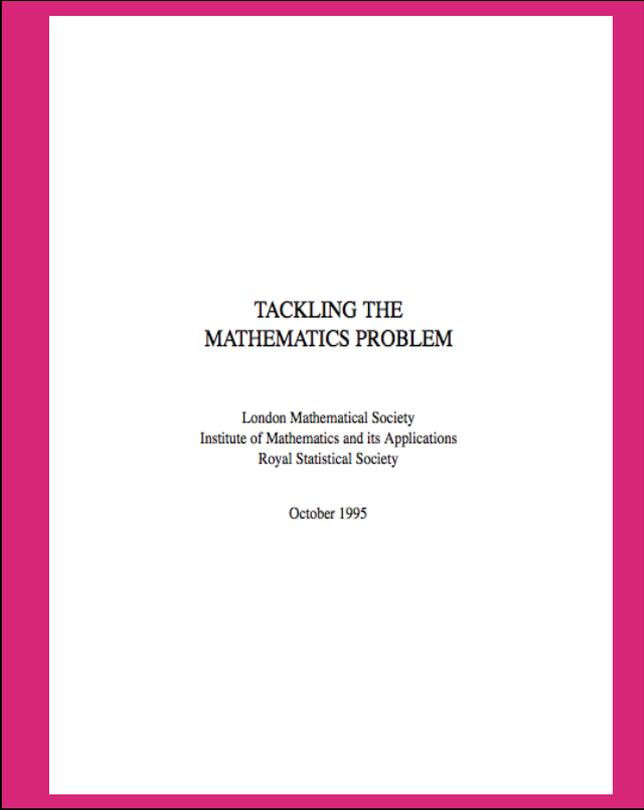


## TACKLING THE MATHEMATICS PROBLEM

London Mathematical Society  
Institute of Mathematics and its Applications  
Royal Statistical Society

October 2005

## The “mathematics problem” – a plethora of reports



TACKLING THE  
MATHEMATICS PROBLEM

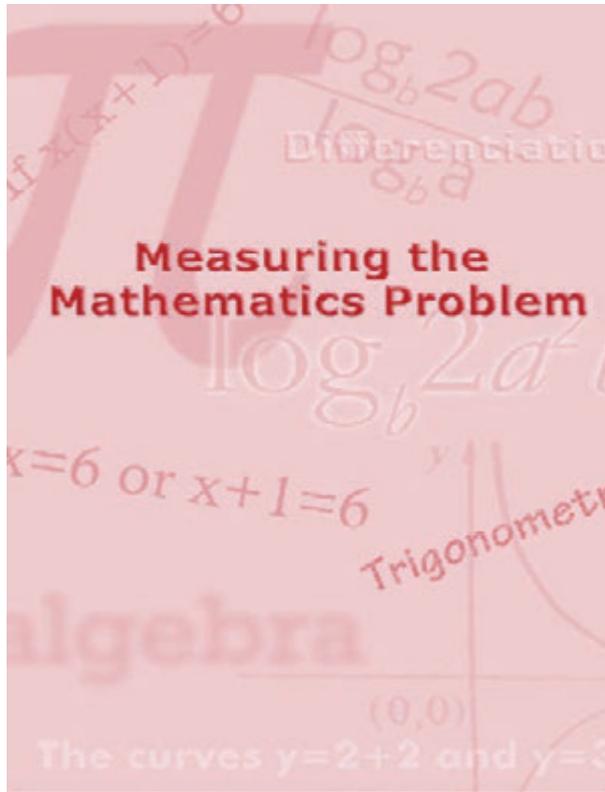
London Mathematical Society  
Institute of Mathematics and its Applications  
Royal Statistical Society

October 1995

*There is unprecedented concern amongst mathematicians, scientists and engineers in higher education about the mathematical preparedness of new undergraduates.*

*LMS, IMA, RSS, 1995,  
Tackling the Mathematics Problem.*

## The “mathematics problem”– a plethora of reports

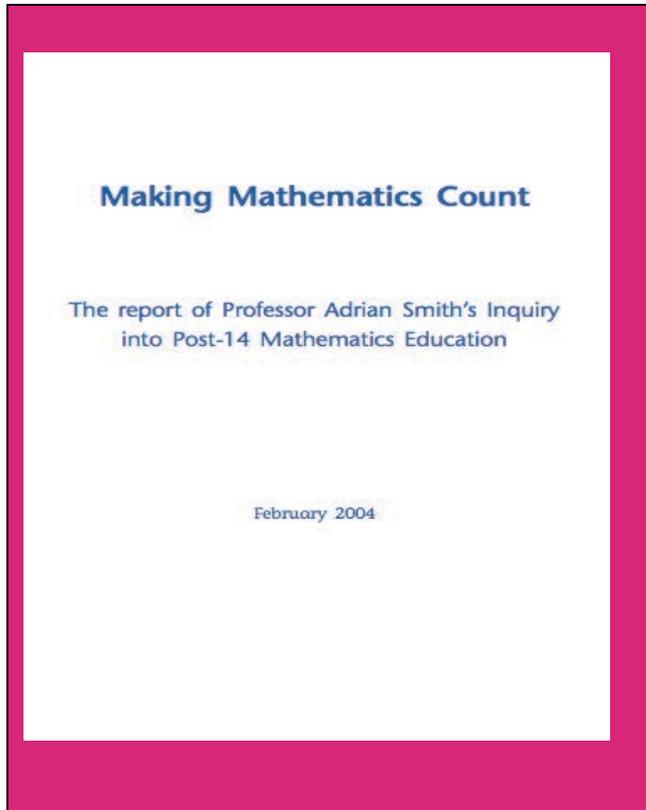


*Acute problems* now confront those teaching mathematics and mathematics-based modules *across the full range of universities*.....

*Prompt and effective support should be available to students whose mathematical background is found wanting*.....

*Measuring the mathematics problem.  
Engineering Council (2000)*

## The “mathematics problem” – a plethora of reports



*higher education has little option but to accommodate to the students emerging from the current GCE [ie pre-university schooling] process.*

*Prof. Sir Adrian Smith, 2004,  
Making Mathematics Count: Section 4.39*

## What about more recently ?

The screenshot shows a BBC News article from June 14, 2011. The article is titled "Universities 'dumbing down on maths' to fill places" and is written by Hannah Richardson. The main text states that universities are lowering math requirements to fill seats, and that nearly two-thirds of students on post-GCSE math courses lack the necessary skills. It also mentions that the Advisory Committee on Mathematics Education report argues this causes problems for students. A photo of a chalkboard with math equations is included, with a caption stating "Maths is required for many subjects at degree level".

**Universities 'dumbing down on maths' to fill places**

By Hannah Richardson  
BBC News education reporter

Universities are having to dumb down the maths requirements on some of their courses in order to fill places, a report says.

It maintains that nearly two-thirds of the students accepted on courses needing post-GCSE maths do not have those skills.

The Advisory Committee on Mathematics Education report argues that this causes problems for students.

Maths is required for many subjects at degree level

Ministers want students who fail GCSE maths to take it up to the age of 18.

Related Stories

- ACME – Advisory Committee on Mathematics Education – **June 2011**
- *We estimate that of those entering higher education in any year, some **330,000** would benefit from recent experience of studying some mathematics (including statistics) at a level beyond GCSE.*
- *At the moment fewer than **125,000** have done so.*
- **Over 60% of students entering higher education courses which require good mathematical skills beyond GCSE level have not benefitted from higher level study**

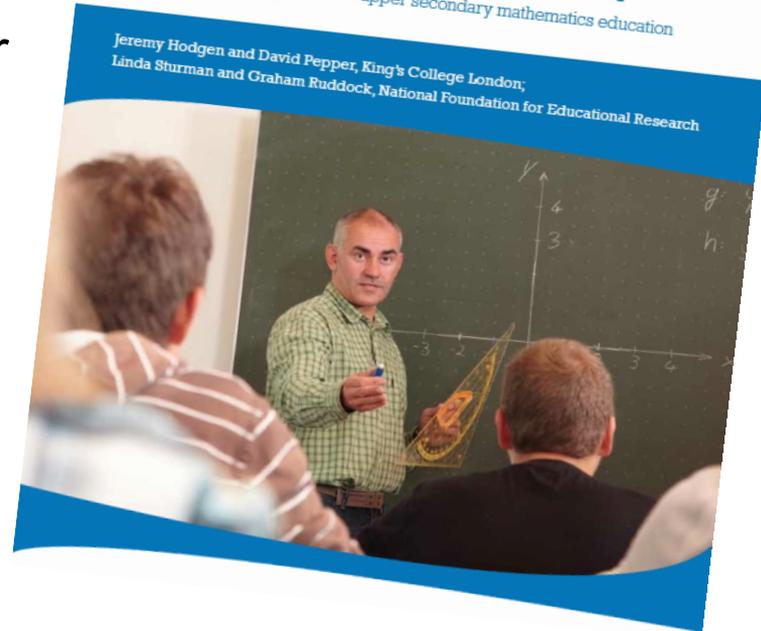
# Is the UK an outlier in upper secondary maths education ?



## Is the UK an outlier?

An international comparison of upper secondary mathematics education

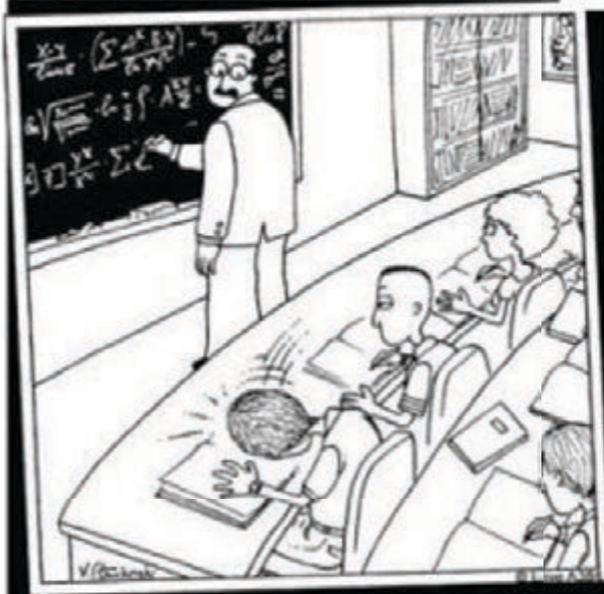
Jeremy Hodgen and David Pepper, King's College London;  
Linda Sturman and Graham Ruddock, National Foundation for Educational Research



- Nuffield Foundation Report (2010)
- In a survey of 24 countries, England, Wales and Northern Ireland had the lowest levels of participation in upper secondary mathematics.
- They were the **only** countries in which fewer than 20% of upper secondary students study maths. This includes all mathematics qualifications at this level.
- England, Scotland, Wales and Northern Ireland are four of only six countries that do not require compulsory participation in mathematics at upper secondary for any students.

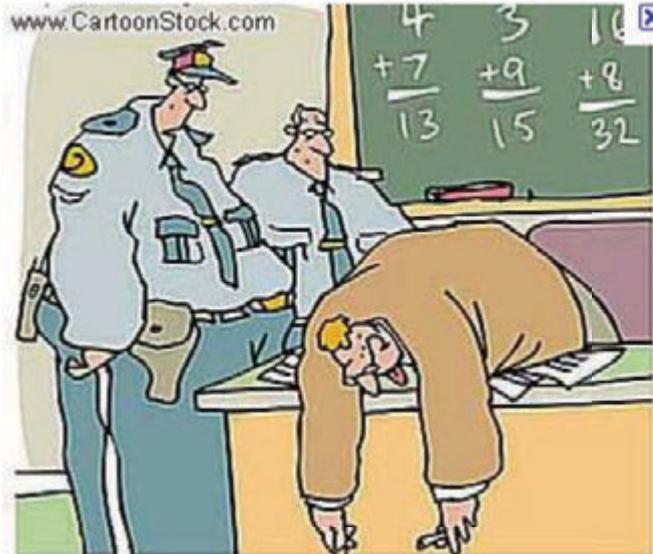
# That's the "mathematics problem" !

Snapshots at jasonlove.com



Professor Herman stopped when he heard that unmistakable thud – another brain had implicated.

www.CartoonStock.com



"Brilliant mathematician. Teaching second grade. Dies suddenly from no apparent cause. Something just doesn't add up."

So what have we been trying to do about it ?

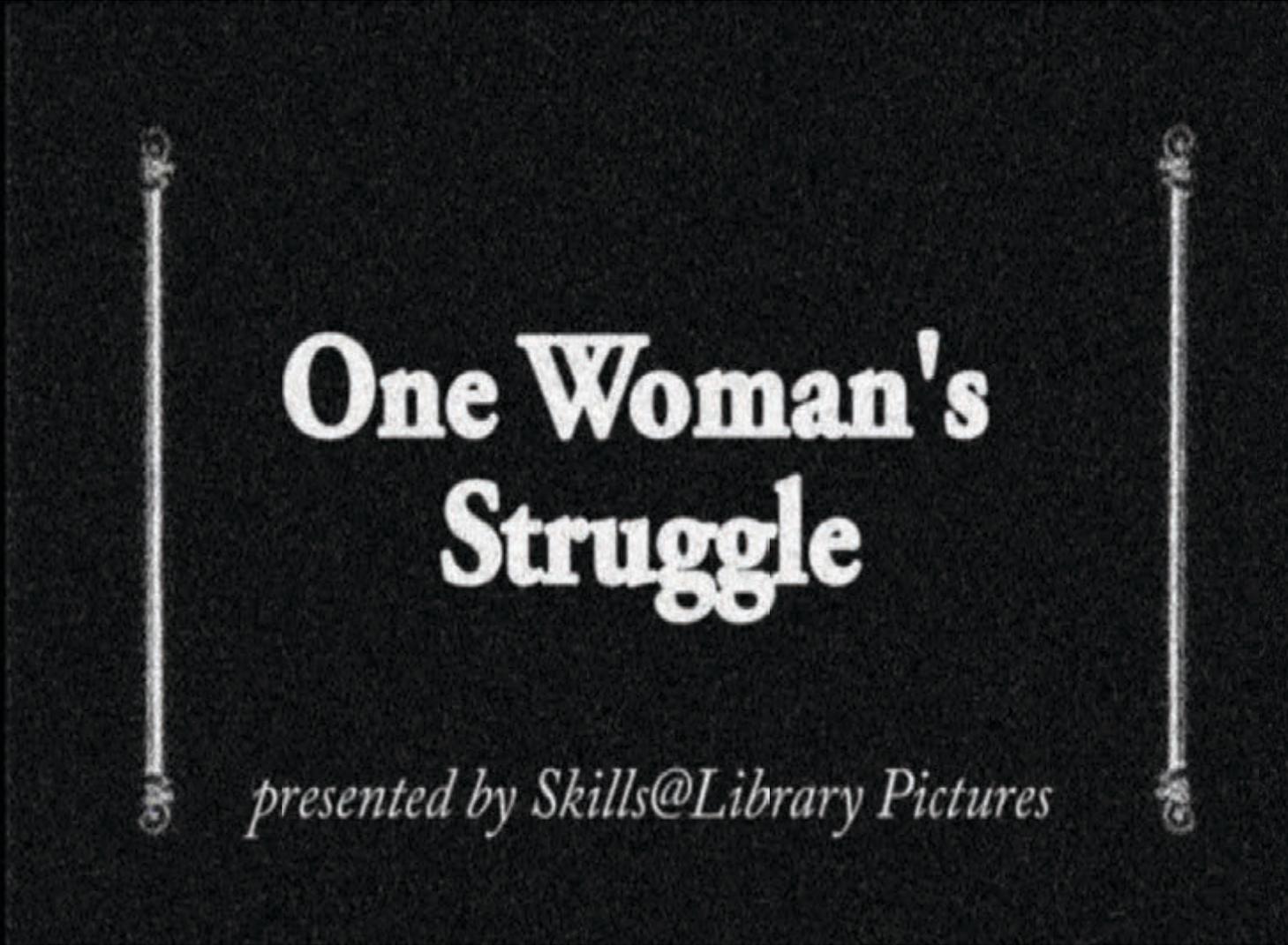


## Mathematics support – what is it ?

- activities and resources provided to support and enhance students' learning of mathematics and statistics, **in any discipline**, at any level of higher education and which are **provided in addition** to traditional lectures, tutorials, examples classes, personal tutorial sessions....
- Non-judgmental, informal, not credit-bearing
- Pleasant and non-threatening
- Supportive
- Offers alternative ways of looking at problems that students find difficult



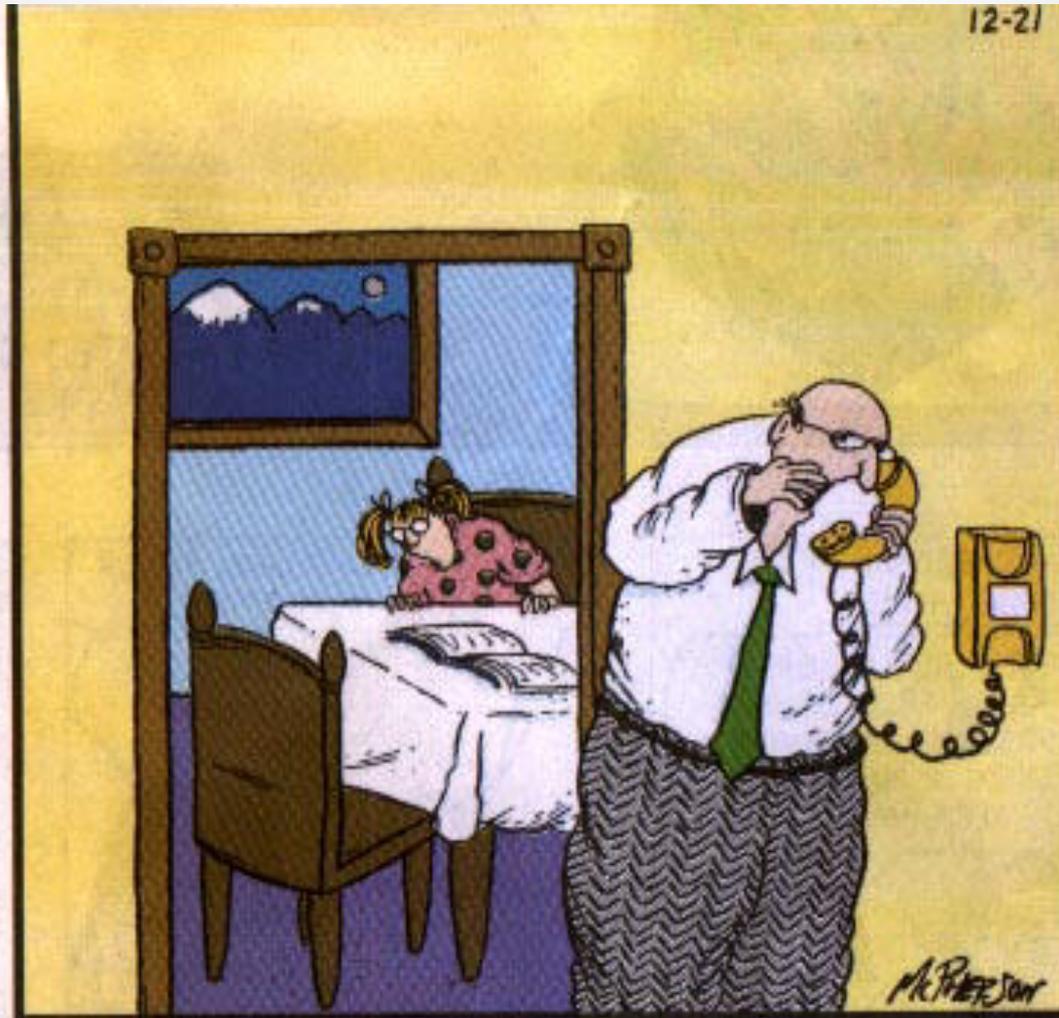
Trying very hard to overcome attitudinal problems....



# One Woman's Struggle

*presented by Skills@Library Pictures*

## Mathematics support – what is it ?



"Uh, yeah, Homework Help Line? I need to have you explain the quadratic equation in roughly the amount of time it takes to get a cup of coffee."

# The first Loughborough Centre 1996



1000's since

## mathcentre and mathtutor



# A wealth of maths support resources



## Integration by parts

mc-TY-parts-2009-1

A special rule, **integration by parts**, is available for integrating products of two functions. This unit derives and illustrates this rule with a number of examples.

In order to master the techniques explained here it is vital that you undertake plenty of practice exercises so that they become second nature.

After reading this text, and/or viewing the video tutorial on this topic, you should be able to:

state the formula for integration by parts

integrate products of functions using integration by parts

### Contents

- |   |   |
|---|---|
| 1. Introduction                                       | 2 |
| 2. Derivation of the formula for integration by parts | 2 |
| 3. Using the formula for integration by parts         | 5 |

$$\int u \frac{dv}{dx} dx = uv - \int v \frac{du}{dx} dx$$

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mathcentre community project

encouraging academics to share maths support resources  
All mcpp resources are released under an Attribution Non-commercial Share Alike licence

## Eigenvalues and eigenvectors

mccp-croft-0901 September 9, 2010

### Introduction

This leaflet summarises how eigenvalues and eigenvectors of a square matrix are found.

### The characteristic equation

Given a square  $n \times n$  matrix  $A$ , we can form a new matrix  $A - \lambda I$ , where  $\lambda$  is an (as yet) unknown number and  $I$  is the  $n \times n$  identity matrix. For example, if we start with the  $2 \times 2$  matrix

$$A = \begin{pmatrix} 3 & 1 \\ -1 & 5 \end{pmatrix}$$

then we can form

$$A - \lambda I = \begin{pmatrix} 3 & 1 \\ -1 & 5 \end{pmatrix} - \lambda \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$$

which is simplified to

$$A - \lambda I = \begin{pmatrix} 3-\lambda & 1 \\ -1 & 5-\lambda \end{pmatrix}$$

If we now evaluate the determinant of  $A - \lambda I$  we obtain what is called the **characteristic polynomial** of  $A$ . In this case,

$$A - \lambda I = \begin{vmatrix} 3-\lambda & 1 \\ -1 & 5-\lambda \end{vmatrix} = (3-\lambda)(5-\lambda) - (1)(-1) = \lambda^2 - 8\lambda + 16$$

So the characteristic polynomial in this example is the quadratic polynomial  $\lambda^2 - 8\lambda + 16$ . The **characteristic equation** is

$$\lambda^2 - 8\lambda + 16 = 0$$

In the case of a  $3 \times 3$  matrix the characteristic polynomial will be cubic, and the algebra gets a little more tedious, but the method of calculation is the same.

### Eigenvalues

The eigenvalues of a matrix  $A$  are the solutions of its characteristic equation. For example the eigenvalues of  $A = \begin{pmatrix} 3 & 1 \\ -1 & 5 \end{pmatrix}$  are found by solving  $\lambda^2 - 8\lambda + 16 = 0$ . Thus

$$\begin{aligned} \lambda^2 - 8\lambda + 16 &= 0 \\ (\lambda - 4)(\lambda - 4) &= 0 \\ \lambda &= 4 \quad (\text{twice}) \end{aligned}$$

In this example there is one (repeated) eigenvalue,  $\lambda = 4$ . You should note that in a more general  $2 \times 2$  case, the solution of the quadratic characteristic equation may yield two real distinct eigenvalues, or perhaps two complex eigenvalues.



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Dr Andrew Young  
Loughborough University

Professor Leslie Pennington  
Liverpool John Moores University

# Maths support for pharmacists

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## Maths for Pharmacy

### MathTutor

 Arithmetic

Includes fractions, percentages, ratios, etc.

 Algebra

Includes powers, logarithms, rearranging equations, etc.

 Functions

Includes linear/log/exponential functions, sequences/series etc.

### Refresher Booklets

 Numeracy Refresher Booklet [273.0 Kb]

 Algebra Refresher Booklet [341.7 Kb]

### Online Quizzes - (Read important notes)

[Online Pharmaceutical Calculations Exercise \(Log-in required\).](#)

[General Algebra Quiz](#)

[Basic Statistics Quiz](#)

[Coordinate Geometry Quiz](#)

[Length, Area, Volume Quiz](#)

[Logs Quiz](#)

### Important Notes

 [Using the Online Quizzes \[28.0 Kb\]](#)

 [Log-in details for Calculations Exercise \[39.0 Kb\]](#)

### Related Links

 [Pharmacy Calculations-Workbook](#)

 [Pharmacy Calculations - How to guide](#)

 [Pharmacy Calculators](#)

### School Website

[Cardiff School of Pharmacy](#)

[↑ Back to top](#)

## What maths do pharmacists need ?

**This is something I hope to learn more about today:**

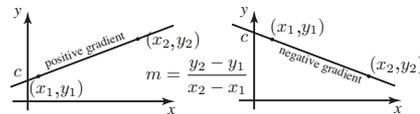
- **? Numeracy: ratios, %, arithmetic, fractions...**
- **? Units of measurement, conversions**
- **? Doses, concentrations, molarity**
- **? Basic algebra: rearranging formulae**
- **? Some common functions and their graphs:  
logarithm, exponential**
- **? Differential calculus: chemical kinetics**

**but what about: trigonometry ? Integral calculus ?  
differential equations ?**

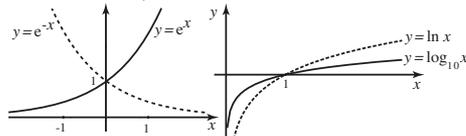
# mathcentre has resources to help

## Graphs of common functions

The straight line:  $y = mx + c$ .  
 $m$  = gradient (slope),  $c$  = vertical intercept.

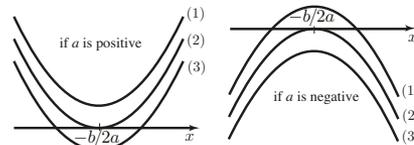


Exponential and log functions:  
 $e \approx 2.718$  is the exponential constant.



Graph of  $y = e^x$  and  $y = e^{-x}$  showing exponential growth/decay. Graph of  $y = \ln x$  and  $y = \log_{10} x$ .

Quadratic functions:  $y = ax^2 + bx + c$



- |                     |                     |
|---------------------|---------------------|
| (1) $b^2 - 4ac < 0$ | (1) $b^2 - 4ac > 0$ |
| (2) $b^2 - 4ac = 0$ | (2) $b^2 - 4ac = 0$ |
| (3) $b^2 - 4ac > 0$ | (3) $b^2 - 4ac < 0$ |

## Statistics

Population values, or **parameters**, are denoted by Greek letters. Population mean =  $\mu$ . Population variance =  $\sigma^2$ . Population standard deviation =  $\sigma$ . Sample values, or **estimates**, are denoted by roman letters.

The **mean** of a sample of  $n$  observations  $x_1, x_2, \dots, x_n$  is

$$\bar{x} = \frac{\sum_{i=1}^n x_i}{n} = \frac{x_1 + x_2 + \dots + x_n}{n}$$

The sample mean  $\bar{x}$  is an unbiased estimate of the population mean  $\mu$ . The unbiased estimate of the **variance** of these  $n$  sample observations is  $s^2 = \frac{\sum_{i=1}^n (x_i - \bar{x})^2}{n-1}$  which can be written as

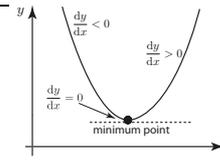
$$s^2 = \frac{1}{n-1} \sum_{i=1}^n x_i^2 - \frac{n\bar{x}^2}{n-1}$$

The sample unbiased estimate of **standard deviation**,  $s$ , is the square root of the variance:  $s = \sqrt{\frac{\sum_{i=1}^n (x_i - \bar{x})^2}{n-1}}$ . The standard deviation of the sample mean is called the **standard error of the mean** and is equal to  $\frac{s}{\sqrt{n}}$ , and is often estimated by  $\frac{s}{\sqrt{n}}$ .

## Differentiation

Differentiating a function,  $y = f(x)$ , we obtain its derivative  $\frac{dy}{dx}$ . This new function tells us the gradient (slope) of the original function at any point. When  $\frac{dy}{dx} = 0$  the gradient is zero.

$y = f(x)$	$\frac{dy}{dx} = f'(x)$
$k$ , constant	0
$x$	1
$x^2$	$2x$
$x^n$ , constant $n$	$nx^{n-1}$
$\sin(kx)$	$k \cos(kx)$
$\cos(kx)$	$-k \sin(kx)$
$e^x$	$e^x$
$e^{kx}$	$ke^{kx}$
$\ln kx = \log_e kx$	$\frac{1}{x}$



The **linearity rules**:

$$\frac{d}{dx}(u(x) \pm v(x)) = \frac{du}{dx} \pm \frac{dv}{dx}$$

$$\frac{d}{dx}(k \times f(x)) = k \times \frac{df}{dx}$$

for  $k$  constant.

The **product and quotient rules**:

$$\frac{d}{dx}(uv) = u \frac{dv}{dx} + v \frac{du}{dx}$$

$$\frac{d}{dx} \left( \frac{u}{v} \right) = \frac{v \frac{du}{dx} - u \frac{dv}{dx}}{v^2}$$

The **chain rule**:

If  $y = y(u)$  where  $u = u(x)$  then  $\frac{dy}{dx} = \frac{dy}{du} \times \frac{du}{dx}$ .

**Higher derivatives**:  $f''(x)$ , or  $\frac{d^2f}{dx^2}$ , means differentiate  $\frac{df}{dx}$  with respect to  $x$ . That is,  $\frac{d^2f}{dx^2} = \frac{d}{dx} \left( \frac{df}{dx} \right)$ .

**Partial derivatives**: If  $f = f(x, y)$  is a function of two (or more) independent variables,  $\frac{\partial f}{\partial x}$  means differentiate  $f$  with respect to  $x$  treating  $y$  as if it were a constant.  $\frac{\partial f}{\partial y}$  means differentiate  $f$  with respect to  $y$  treating  $x$  as if it were a constant.

## Integration

$f(x)$	$\int f(x) dx$
$k$ , constant	$kx + c$
$x$	$\frac{x^2}{2} + c$
$x^2$	$\frac{x^3}{3} + c$
$x^n$ , ( $n \neq -1$ )	$\frac{x^{n+1}}{n+1} + c$
$x^{-1} = \frac{1}{x}$	$\ln x + c$ or $\ln c'x$
$e^x$	$e^x + c$
$e^{kx}$	$\frac{e^{kx}}{k} + c$
$\sin kx$	$-\frac{1}{k} \cos kx + c$
$\cos kx$	$\frac{1}{k} \sin kx + c$

The **linearity rule**:

$$\int (af(x) + bg(x)) dx = a \int f(x) dx + b \int g(x) dx, \quad (a, b \text{ constant})$$

**Integration by parts**:  $\int_a^b u \frac{dv}{dx} dx = [uv]_a^b - \int_a^b \frac{du}{dx} v dx$ .

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For the help you need to support your course

# Mathematics for Chemistry Facts & Formulae

mathcentre is a project offering students and staff free resources to support the transition from school mathematics to university mathematics in a range of disciplines.



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This leaflet has been produced in conjunction with the Higher Education Academy Maths, Stats & OR Network, the UK Physical Sciences Centre, and sigma

For more copies contact the Network at info@mathstore.ac.uk



# mathcentre has resources to help



## Dilution of solutions for nurses

### Introduction

In order to maximize all available storage space most solutions are stored in a concentrated form (known as **stock**). These solutions are then diluted to the required strength as and when required for the individual patient. This also means the same solution substance may be used for a different range of treatments. This leaflet explains how dilution calculations are performed.

### The strength of a solution

When stating the strength of solution required it may be expressed in **percentage strength**, in **grams per litre**, **millilitre per millilitre** or as **ratio strength**. Whenever it is expressed as a percentage there is an equivalent ratio and similarly if expressed as a ratio it could also be expressed as a percentage. For practical purposes weak or very dilute solutions ratios of 1:1000, 1:2000 and 1:5000 may be written as  $\frac{1}{1000}$ ,  $\frac{1}{2000}$ ,  $\frac{1}{5000}$  rather than the more accurate  $\frac{1}{1001}$ ,  $\frac{1}{2001}$ ,  $\frac{1}{5001}$ . Remember that the word percent means parts per hundred. For example 5% means 5 parts per hundred parts. As a ratio it would be written as 5 in 100 or simplified to 1 in 20. Whatever form the strength is given in, we always use the same equation:

$$\text{Amount of stock required} = \frac{\text{Strength Required}}{\text{Stock Strength}} \times \text{Volume Required}$$

**Example** Calculate the amount of (i) stock solution required, and (ii) water required to make 1.5 litres of 10% solution

**Solution** 10% solution strength is equivalent to 1/10. 100% Stock Strength.

$$\begin{aligned} \text{Amount of stock required} &= \frac{\text{Strength Required}}{\text{Stock Strength}} \times \text{Volume Required} \\ &= \frac{1}{10} \times 1.5 \\ &= 0.15 \text{ litres} \\ &= 150 \text{ ml} \end{aligned}$$

Reviewed by: Aiping Xu  
University of Coventry



## Nursing Medication Calculation Formulae

- Right Patient
- Right Time/Frequency
- Right Dose
- Right Route
- Right Drug

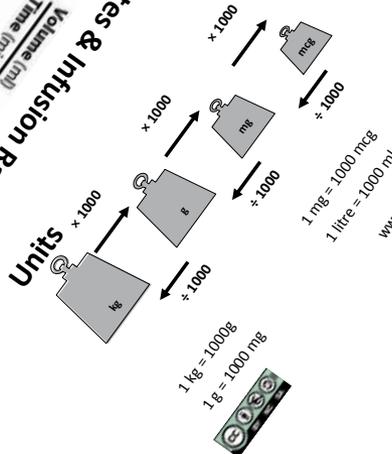
© Shazida Ahmed  
University of Glasgow

$$\text{Dose} = \frac{\text{WANT}}{\text{GOT}} \times \text{IN}$$

- Concentration**
  - Ratio
  - 1: something (one in something)
  - Percentages means grams in ml's e.g. 1:100 means 1g in 100ml
  - Weight in volume (w/v) - solid dissolved in liquid, e.g. Glucose 5%(w/v) = 5g Glucose in every 100 ml

## Drop Rates & Infusion Rates

$$\begin{aligned} \text{Rate (ml/min)} &= \frac{\text{Volume (ml)}}{\text{Time (min)}} \\ \text{Rate (ml/min)} &= \frac{\text{Volume (ml)}}{\text{Time (min)}} \times \text{Time (min)} \\ \text{Volume (ml)} &= \text{Rate (ml/min)} \times \text{Time (min)} \end{aligned}$$



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mathematics and statistics support



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the JISC mailing list by clicking this link :

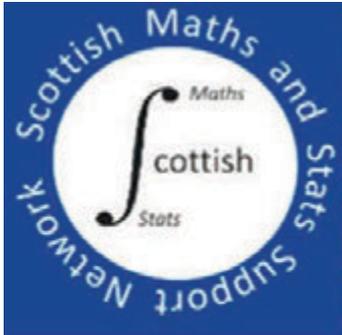
## 2010 the sigma network – sigma goes national!

- Six regional hubs offering local events:

training  
workshops  
resource production  
networking  
sharing practice



# Extensive influence – the Scottish Network



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## Scottish Mathematics and Statistics Support Network

### Welcome

This is the Scottish Mathematics and Statistics Network website; a forum for those interested in the provision of maths support in tertiary education in Scotland.

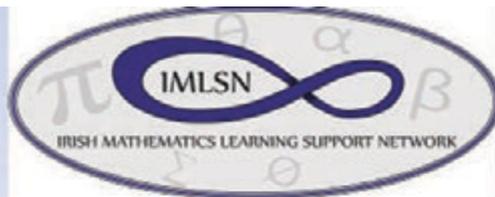
The network was founded in 2008 following two events held at the University of St Andrews: a Maths Support (Scotland) workshop held in July 2008 and a conference (Addressing the Quantitative Skills Gap: Establishing and Sustaining Cross-Curricular Mathematical Support in Higher Education) held from 25 - 27 June 2007.

The Scottish Mathematics and Statistics Network and its events are actively supported and generously sponsored by SIGMA and the Maths, Stats & OR Network.

The majority of Scotland's Universities have an individual who is a member of the Scottish Mathematics & Stats Support Network. Additionally we welcome members from Scotland's specialist HEIs.



# Extensive influence – the Irish Network



## Irish Mathematics Learning Support Network

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[Contacts](#)
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[Resources](#)
[Research Papers & Reports](#)

### Welcome

This is the website for the Irish Mathematics Learning Support Network (IMLSN). It was officially launched in December 2011 and the official logo (top left corner) was also announced.

The IMLSN was established in 2009 following a meeting held at the National University of Ireland Maynooth. This meeting was attended by people involved in the provision of extra mathematics services at third level in Ireland and the attendees were advised by experts from NCE-MSTL (The National Centre for Excellence in Mathematics and Science Teaching and Learning) and sigma (Centre for Excellence in Mathematics and Statistics Support).

The aim of the IMLSN is to act as an informal focus point for all those who are interested in the provision of mathematics and statistics support at third level in Ireland.

To date we have organised a number of [events](#) and [projects](#).

We have been supported and sponsored by a number of organisations including AISHE (The All-Ireland Society for Higher Education), NCE-MSTL (The National Centre for Excellence in Mathematics and Science Teaching and Learning), NDLR (National Digital Learning Resources) and sigma (Centre for Excellence in Mathematics and Statistics Support).

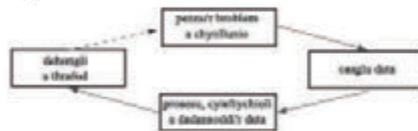
The majority of third level institutions in Ireland have some level of maths support and a list of contacts is available [here](#). Anyone who is interested in organising events or participating in the Network's activities please contact us.

### News Items

- The ALM 21 Conference, Adults Learning Mathematics inside and outside the classroom, takes place June 29, 2014 until July 2, 2014 in Bern, Switzerland. Details can be found [here](#).
- CETL-MSOR 2014 takes place in Cardiff University Monday 8th and Tuesday 9th September 2014. The conference theme is 'Mathematics and Statistics Teaching, Learning and Support: Real, Virtual, Mobile'. Details can be found [here](#).
- Further information, including the presentations, from the [8th Annual Workshop of the IMLSN](#) are available.
- A newly developed [resource](#) has just been added to the sigma network website aimed at supporting those who wish to get started in pedagogic research. It may be of interest to those wishing to explore how to investigate the impact of mathematics support activities.
- Previous news is archived [here](#).

# Extensive influence – Welsh Language editions

Nod ystadegaeth yw cael gwybodaeth allan o ddata sydd ar ffurf rhifau mewn rhyw gydeustun penodol. Fel arfer mae hyn yn golygu datrys problem. Mae gweithred neu baraddeim ar gyfer datrys problem ystadegol neu ymholiad gwyddonol yn cael ei ddisgrifio yn y diagram isod. Mae'r llinell ddotiog yn cyfeirio at sefyllfa, lle ar ôl cael trafodaeth, mae angen ail osod y problem a owbhau o leiaf un iteratd arall.



## Ystadegau disgrifiadol

Os oes gennym sampl o  $n$  arsylwad,  $x_1, x_2, \dots, x_n$ , rydym yn diffinio cymedr y sampl fel

$$\bar{x} = \frac{x_1 + x_2 + \dots + x_n}{n} = \frac{\sum x_i}{n}$$

a'r awm sgwartzau cywrtredig fel

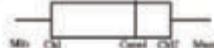
$$S_{xx} = \sum (x_i - \bar{x})^2 = \sum x_i^2 - n\bar{x}^2 = \sum x_i^2 - \frac{(\sum x_i)^2}{n}$$

ac yn aml, gelwir  $\frac{S_{xx}}{n}$  yn wyrtid sgwâr cymedrig. Mae

$s^2 = \frac{S_{xx}}{(n-1)}$  yn amcangyfrifyn diduedd ar gyfer amrywiant y boblogaeth,  $\sigma^2$ . Gwyrtd safonol y sampl yw  $s$ . Wrth gyfrifo  $s^2$ , mae'r rhannnydd  $(n-1)$  yn dynodi nifer y graddau rhyddid. Noder fod  $s$  weithiau'n cael ei ysgrifennu fel  $\hat{\sigma}$ . Os yw'r sampl data wedi'i drefnu o'r lleiaf i'r mwyaf, yna'r:

- isafbwynt (Min) yw'r gwerth lleiaf;
- chwartzel isaf (ChI) yw'r  $\frac{1}{4}(n+1)$ -fed gwerth;
- canolinf (Canol) yw'r gwerth canol (neu'r  $\frac{1}{2}(n+1)$ -fed gwerth);
- chwartzel uchaf (ChU) yw'r  $\frac{3}{4}(n+1)$ -fed gwerth;
- uchafbwynt (Macs) yw'r gwerth mwyaf.

Mae'r pum gwerth uchod yn grynodeb pum rhif o'r data. Mae'n bostb eu cynrychioli â diagram plot bocs a wsgar, sydd fel arfer yn cael ei alw'n blot bocs.



Os yw'r data ar ffurf dosraniad wedi'i gwmpio yn ôl amlder lle mae gennym  $f_i$  arsylwad mewn cyfng  $\bar{x}$  chanolbwynt  $x_i$ , ac os yw  $\sum f_i = n$ , yna mae

$$\bar{x} = \frac{\sum f_i x_i}{\sum f_i} = \frac{\sum f_i x_i}{n}$$

$$S_{xx} = \sum f_i (x_i - \bar{x})^2 = \sum f_i x_i^2 - \frac{(\sum f_i x_i)^2}{n}$$

## Digwyddiadau a thebygolrwyddau

Croestoriad dau ddigwyddiad  $A$  a  $B$  yw  $A \cap B$ . Untad  $A$  a  $B$  yw  $A \cup B$ . Mae  $A$  a  $B$  yn gydanghynhwysol os na all y ddau gymryd lle ar unwaith, caiff hyn ei ddynodi gan  $A \cap B = \emptyset$ , lle gelwir  $\emptyset$  yn ddigwyddiad nwl. Ar gyfer digwyddiad  $A$ , mae  $0 \leq P(A) \leq 1$ . Ar gyfer dau ddigwyddiad  $A$  a  $B$ , mae

$$P(A \cup B) = P(A) + P(B) - P(A \cap B).$$

Os yw  $A$  a  $B$  yn gydanghynhwysol mae

$$P(A \cup B) = P(A) + P(B).$$

## Calyntadau sydd yr un mor debygol

Os yw set gyflwm  $\Omega$  yn canlyniad eifennol cydd yr un mor debygol o ddigwydd, tebygolrwydd pob canlyniad yw  $\frac{1}{n}$ . Os yw digwyddiad  $A$  yn cynnwys  $m$  o'r canlyniadau eifennol  $n$ , mae  $P(A) = \frac{m}{n}$ .

## Digwyddiadau annibynnol

Mae  $A$  a  $B$  yn annibynnol o'u gilydd os ac os yn unig bod  $P(A \cap B) = P(A)P(B)$ .

## Tebygolrwydd Amodol $A$ o wybod $B$ yw

$$P(A|B) = \frac{P(A \cap B)}{P(B)} \quad \text{cyn belled fod } P(B) \neq 0.$$

Theorem Bayes:  $P(B|A) = \frac{P(A|B)P(B)}{P(A)}$

## Theorem Cyfanswm Tebygolrwydd

Mae'r  $k$  digwyddiad  $B_1, B_2, \dots, B_k$  yn ffurfio rhanid o'r golod sampl  $S$  os yw  $B_1 \cup B_2 \cup B_3 \dots \cup B_k = S$  ac ni all dau o'r  $B_i$ 'au ddigwydd yr un pryd a'u gilydd. Yna mae

$$P(A) = \sum P(A|B_i)P(B_i).$$

Yn yr achos hwn, gellir cyffredinoli Theorem Bayes i

$$P(B_i|A) = \frac{P(A|B_i)P(B_i)}{\sum_j P(A|B_j)P(B_j)} \quad (i = 1, 2, \dots, k)$$

Os mai  $B'$  yw cyflenwad  $B$ , mae  $P(B') = 1 - P(B)$  a  $P(A) = P(A|B)P(B) + P(A|B')P(B')$  yn achodon arbennig o'r theorem cyfanswm tebygolrwyddau. Mae'n gyffredin i ddynodi cyflenwad y digwyddiad  $B$  a  $B'$ .



Am yr holl gefnogaeth rydych ei angen a'ch cwrs

Canllaw i Ystadegaeth: Ffeithiau Tebygol ac Ystadegaeth, Fformwlâu a Gwybodaeth

Proiect aml-ddisgyblaethol sy'n cynnig adnoddau rhad ac am ddim i fyfyrwyr a staff er mwyn hwyluso dysgu ac addysgu mathemateg yn yr ysgol a'r brifysgol yw'r mathcentre.

www.mathcentre.ac.uk

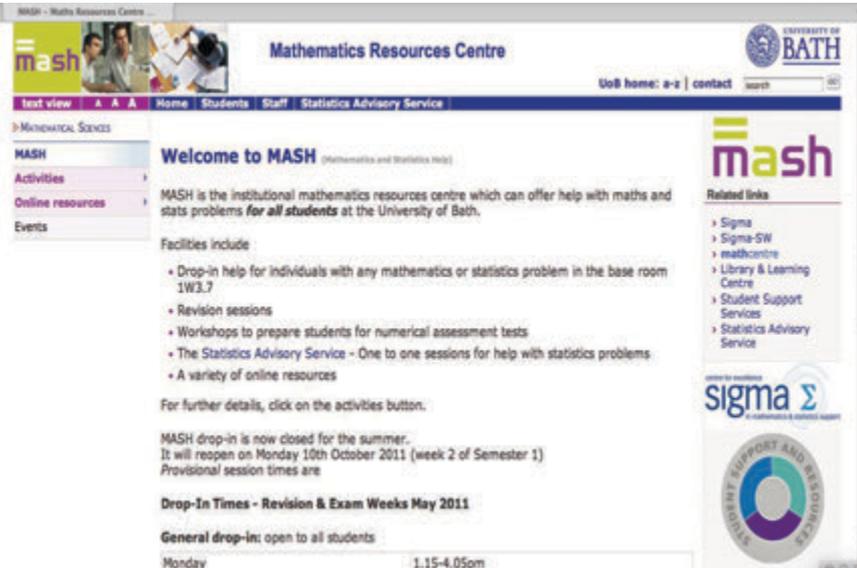


Cynhyrchwyd y daflen hon ar y cyd rhwng yr Higher Education Academy Maths, Stats & OR Network a'r Coleg Cymraeg Cenedlaethol.

Am fwy o adnoddau, ewch i'r Porth www.yporth.ac.uk neu



# Growth in the number of centres in the UK



**MASH - Maths Resources Centre**

UNIVERSITY OF BATH

test view Home Students Staff Statistics Advisory Service

UoB home: a-z | contact search

**Welcome to MASH** (Mathematics and Statistics Help)

MASH is the institutional mathematics resources centre which can offer help with maths and stats problems for **all students** at the University of Bath.

Facilities include

- Drop-in help for individuals with any mathematics or statistics problem in the base room 1W3.7
- Revision sessions
- Workshops to prepare students for numerical assessment tests
- The Statistics Advisory Service - One to one sessions for help with statistics problems
- A variety of online resources

For further details, click on the activities button.

MASH drop-in is now closed for the summer. It will reopen on Monday 10th October 2011 (week 2 of Semester 1) Provisional session times are

**Drop-In Times - Revision & Exam Weeks May 2011**

General drop-in: open to all students

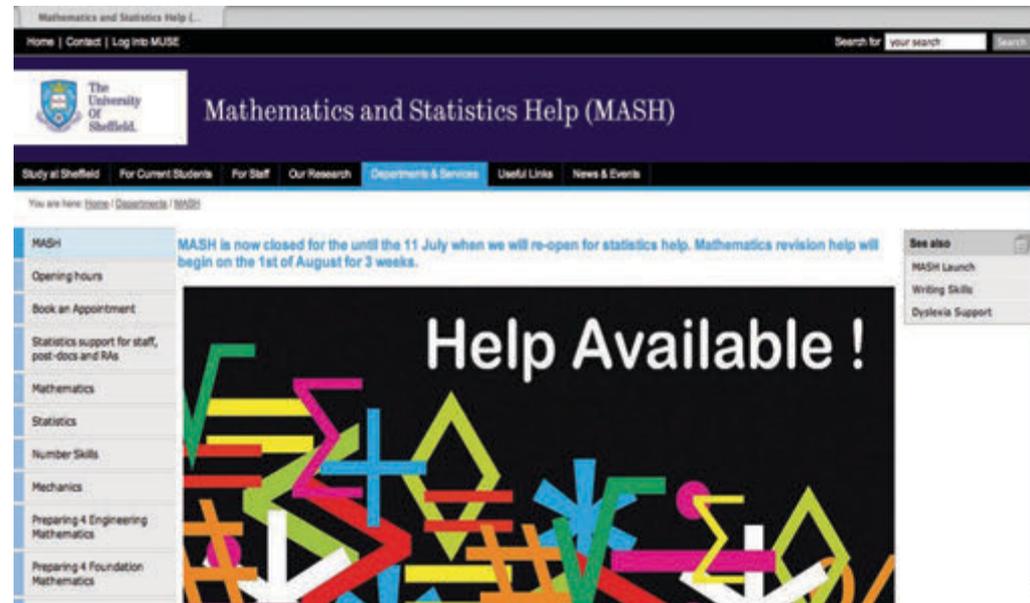
Monday	1.15-4.05pm
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Related links

- Sigma
- Sigma-SW
- mathcentre
- Library & Learning Centre
- Student Support Services
- Statistics Advisory Service

sigma  $\Sigma$  at mathematics and statistics support

ENGINEERING SUPPORT AND RESEARCH

Mathematics and Statistics Help (MASH)

Home | Contact | Log into MUSE

Search for your search

The University of Sheffield

Study at Sheffield For Current Students For Staff Our Research Departments & Services Useful Links News & Events

You are here: Home / Departments / MASH

MASH

MASH is now closed for the until the 11 July when we will re-open for statistics help. Mathematics revision help will begin on the 1st of August for 3 weeks.

Opening hours

Book an Appointment

Statistics support for staff, post-docs and RAs

Mathematics

Statistics

Number Skills

Mechanics

Preparing 4 Engineering Mathematics

Preparing 4 Foundation Mathematics

See also

- MASH Launch
- Writing Skills
- Dyslexia Support

**Help Available !**



## Extent of provision



mathematics learning support in UK higher education

the extent of provision in 2012

	Russell	1994	Alliance	million+	Cathedrals	Unaligned
<b>Total Number Contacted</b>	24	12	20	25	12	26
<b>Identified as providing mathematics support</b>	83%	75%	80%	88%	17%	73%

Table 3: Percentage of institutions, by mission group, providing mathematics support

## Encouraging and establishing further provision

- Maths support at the University of York

In this clip we hear from Dr Andy Pomfret from the Department of Electronics explaining why he wanted to establish maths support for engineering students at York.

## Encouraging and establishing further provision



## Mathematics support is not the prerogative of the weak!

*There has been a tendency to view mathematics support as remedial, targetting the less-able student. The St Andrews Conference sought to redress the balance and emphasise the benefits of mathematics support provision for students of all abilities.*

**RESPONDING TO THE MATHEMATICS PROBLEM:**  
The Implementation of Institutional Support Mechanisms



Edited by C. M. Marr and M. J. Grove

Supported by:

The Wilkinson Charitable Trust

with support from  
**sigma**  $\Sigma$   
SOCIETY OF MATHEMATICS TEACHERS

The Maths, Stats & OR Network



**Mathematics support has a significant role to play in institutions with demanding entrance requirements.**

## Closing remarks

**RESPONDING TO THE  
MATHEMATICS PROBLEM:**  
The Implementation of  
Institutional Support Mechanisms



Edited by C. M. Marr and M. J. Grove

Supported by:

The Wilkinson Charitable Trust



*.....Looking back, I probably regarded mathematics support as a form of cottage industry practised by a few well meaning, possibly eccentric, individuals, who may themselves have been hard pushed to offer a credible rationale for this work.....*

**Joe Kyle (Univ. of Birmingham)**

## Closing remarks

**RESPONDING TO THE  
MATHEMATICS PROBLEM:  
The Implementation of  
Institutional Support Mechanisms**



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Supported by:

The Wilkinson Charitable Trust



*.... Now only a few years on, we see that the concept of mathematics support has not only become firmly embedded in UK Higher Education, but colleagues have moved on to gather data on the way students use such resources and look for optimal strategies for the delivery of this support, and this is perhaps the most convincing evidence of acceptance. Mathematics support came of age in the first decade of the 21st century. What might once have been described as a cottage industry now plays a respected and widely adopted role in Higher Education.*

- The end – Thank you for listening!