Enhancing the mathematical education of undergraduates:

the role of **sigma** and the mathematics support community

Prof. Tony Croft
Mathematics Education Centre
Loughborough University

sigma Σ
network for excellence in mathematics and statistics support

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 **math**centre**, 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

Manchester Evening News

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News

'Cool Cash' card confusion

Ciara Leeming
November 03, 2007

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A Cool Cash Lotto ticket

A LOTTERY scratchcard has been withdrawn from sale by Camelot - because players couldn't understand it.

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.

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.

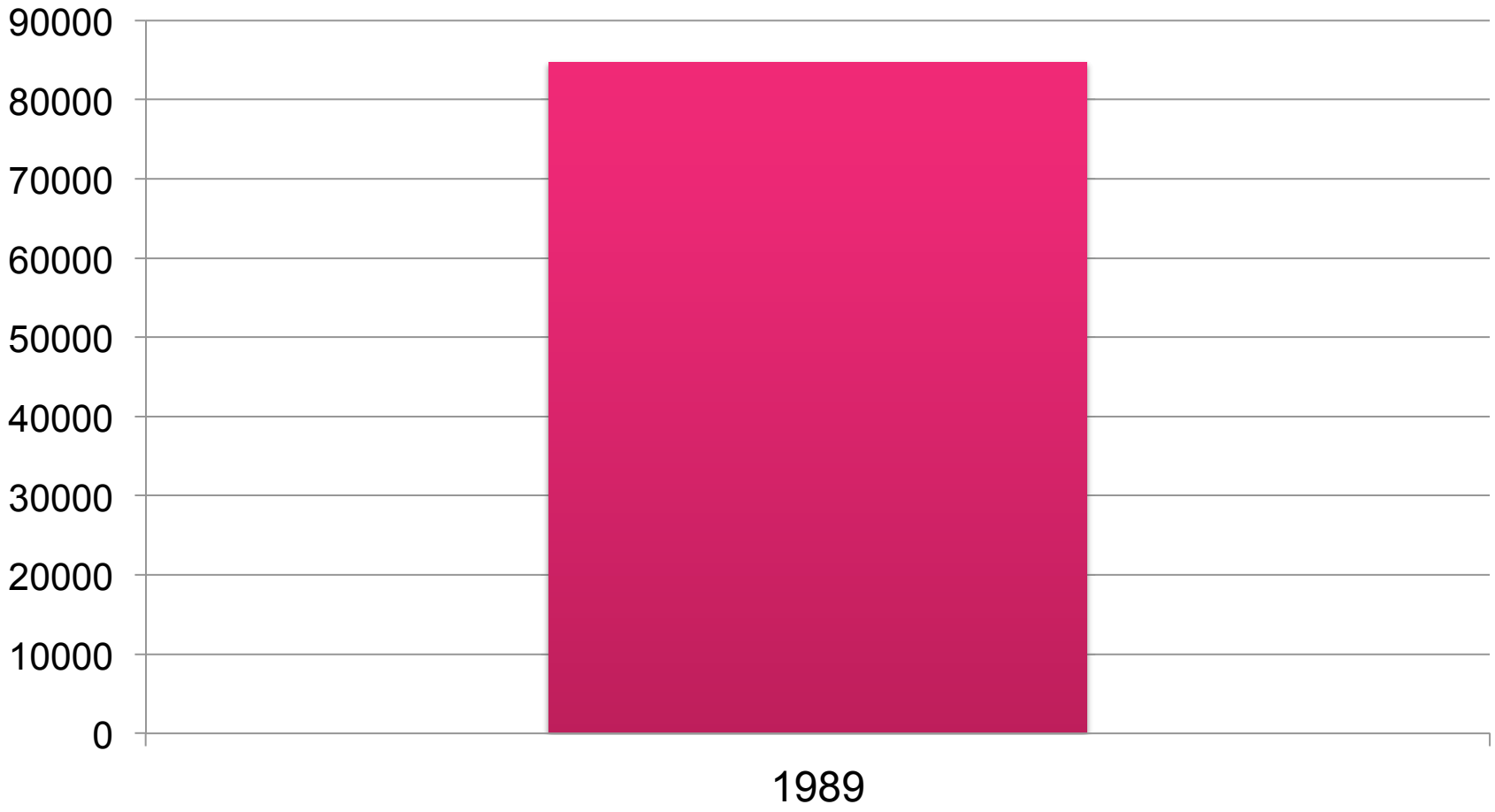
- In 2011, the Skills for Life Survey showed that **numeracy skills in England declined** in the 8 years from 2003, whereas literacy improved.

- 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.

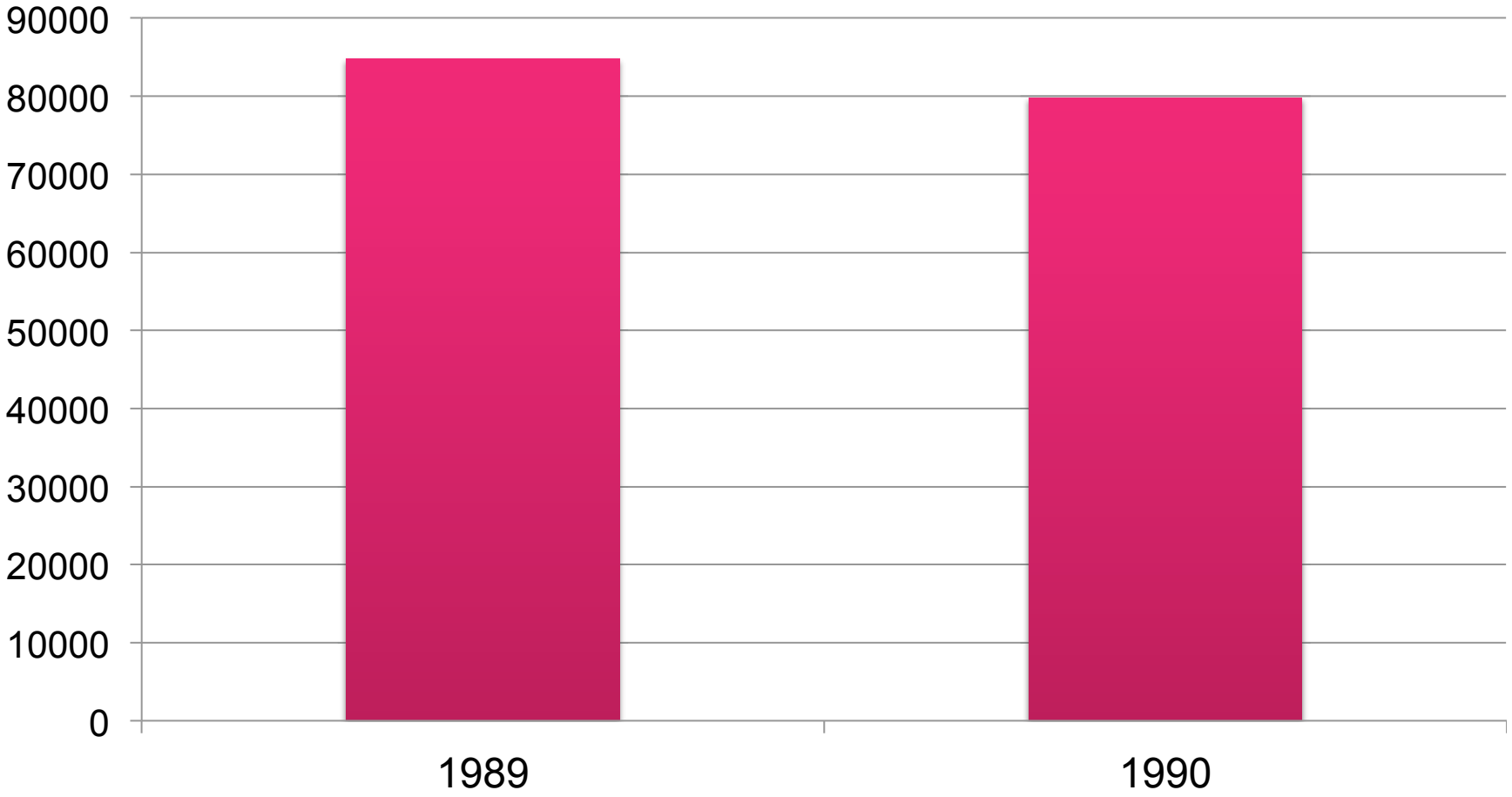
National Numeracy http://www.nationalnumeracy.org.uk/news/16/index.html

Total Mathematics and Further Mathematics A level entries

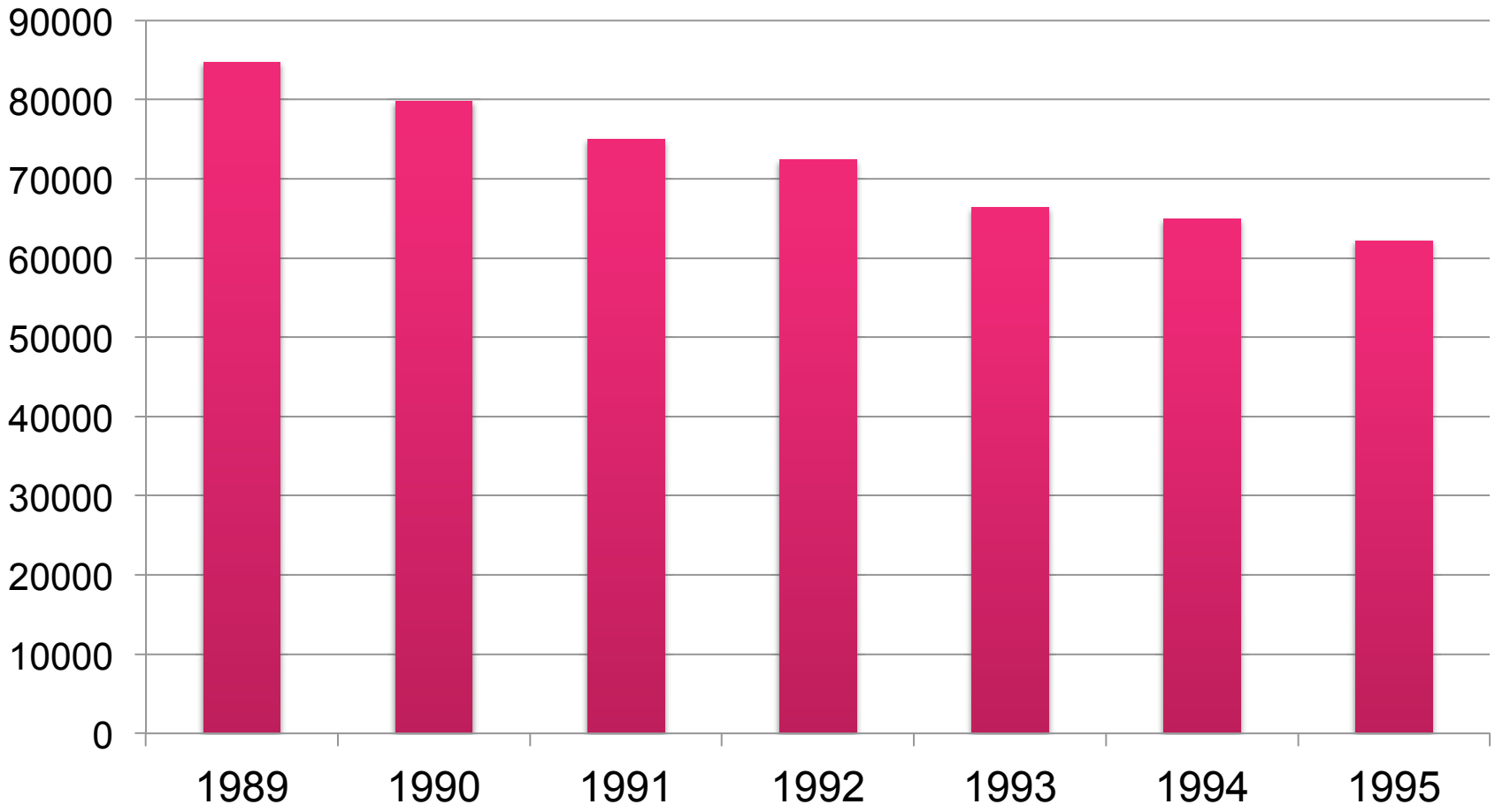


First GCSE sat in 1988

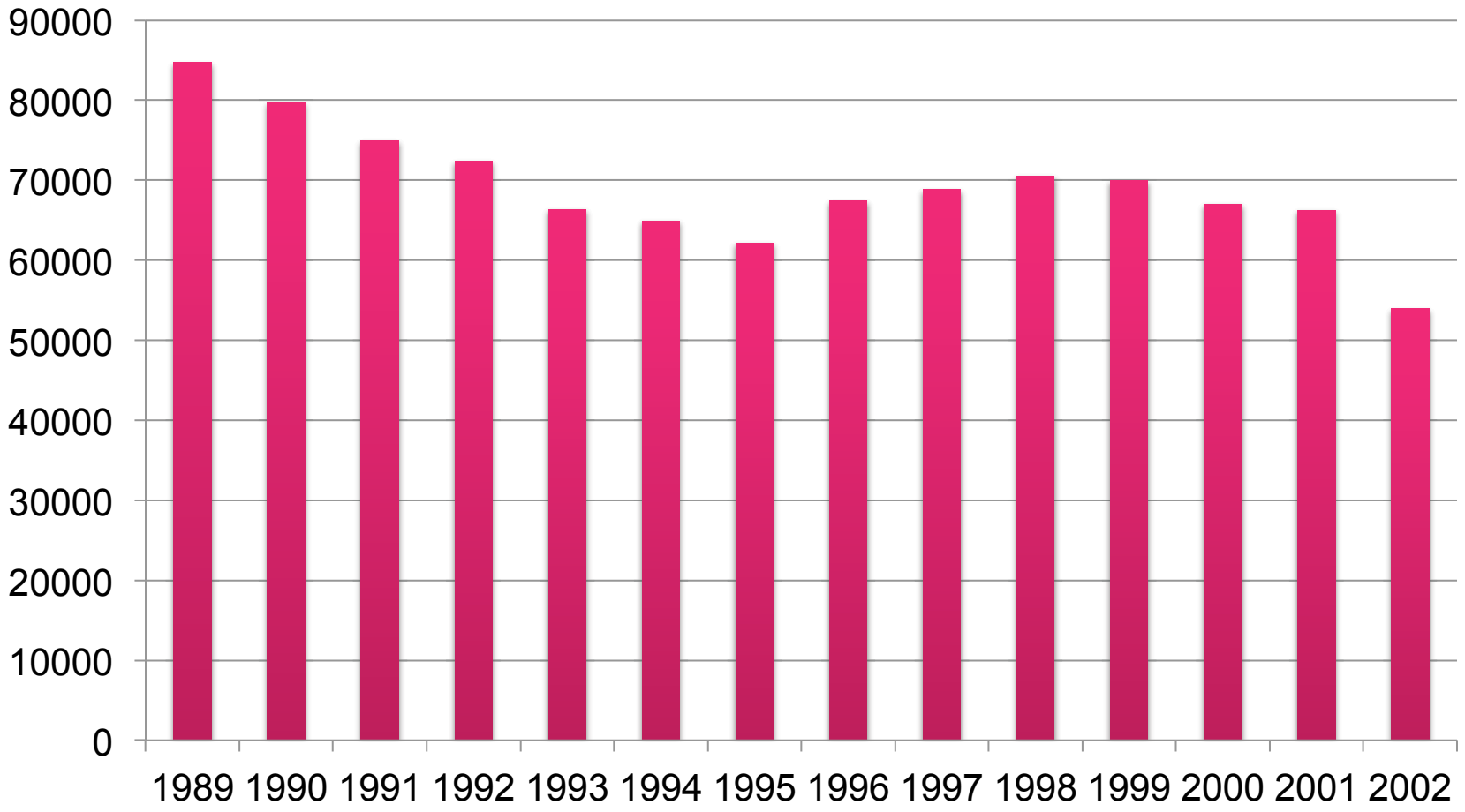
Total Mathematics and Further Mathematics A level entries



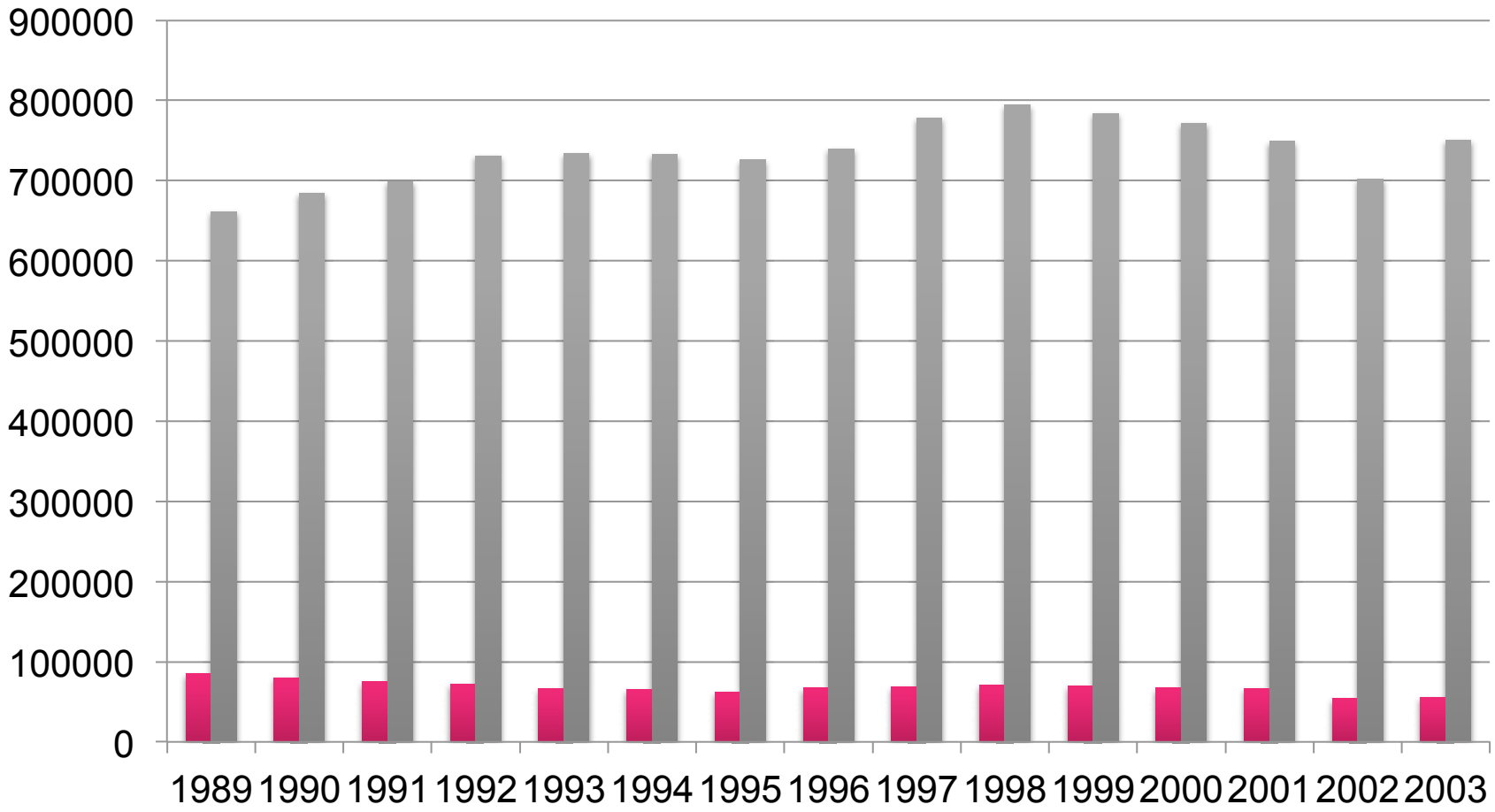
Total Mathematics and Further Mathematics A level entries



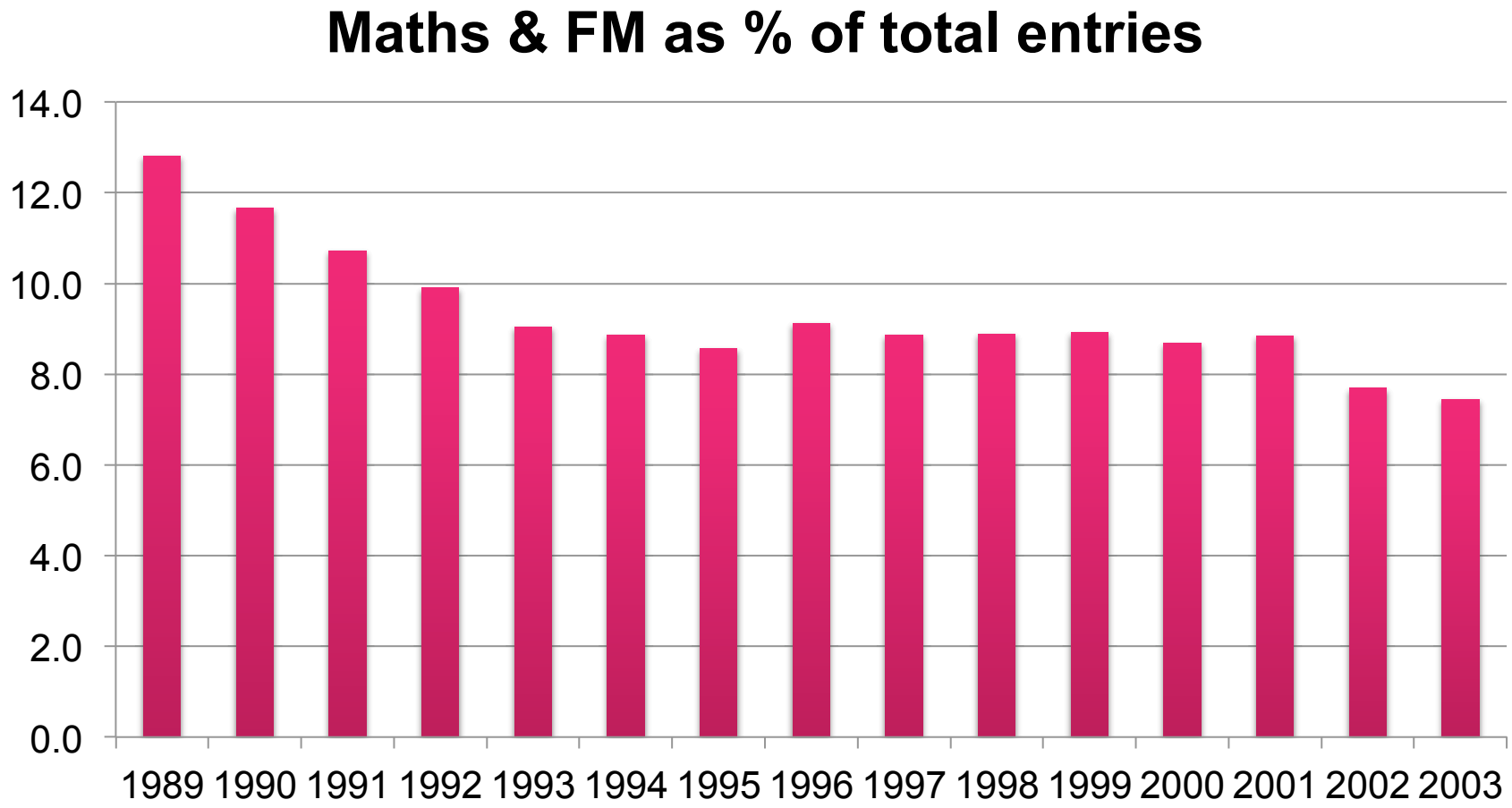
Total Mathematics and Further Mathematics A level entries



Total A level entries compared with Maths & FM entries



Maths & FM as % of total entries



Confidence testing and diagnostic testing

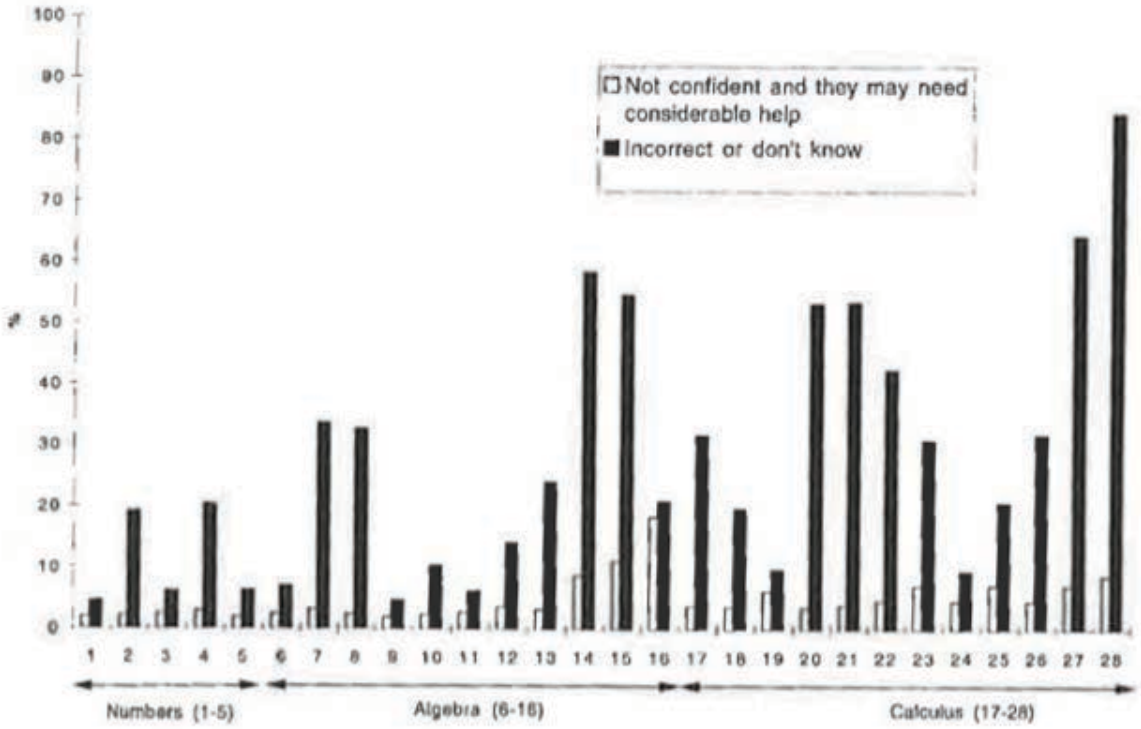


FIG. 12. Comparison of the 1997 Diagnostic Test and the Confidence Survey.

European Journal of Engineering Education 24(1) (1999)

Confidence testing and diagnostic testing

- 1995,1996,1997 Confidence Surveys, Diagnostic Testing

  1997: N=557 (478 >= D in A level maths (86%))

- Simple quadratic equation which will factorize easil

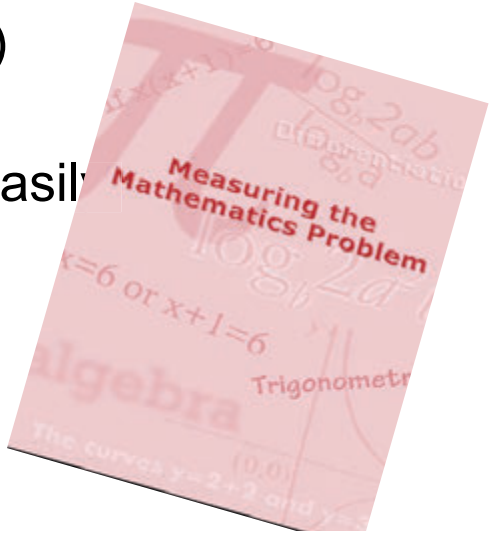
  20% incorrect; 4% don't know

- Quadratic equation requiring use of the formula

  7% incorrect; 31% don't know

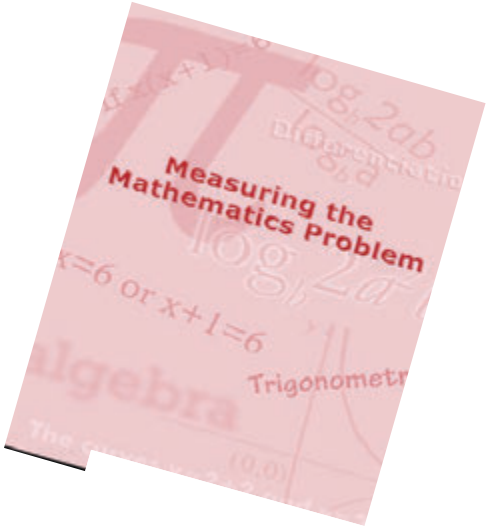
- Simple partial fractions

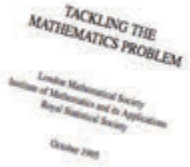
  22% incorrect; 37% don't know



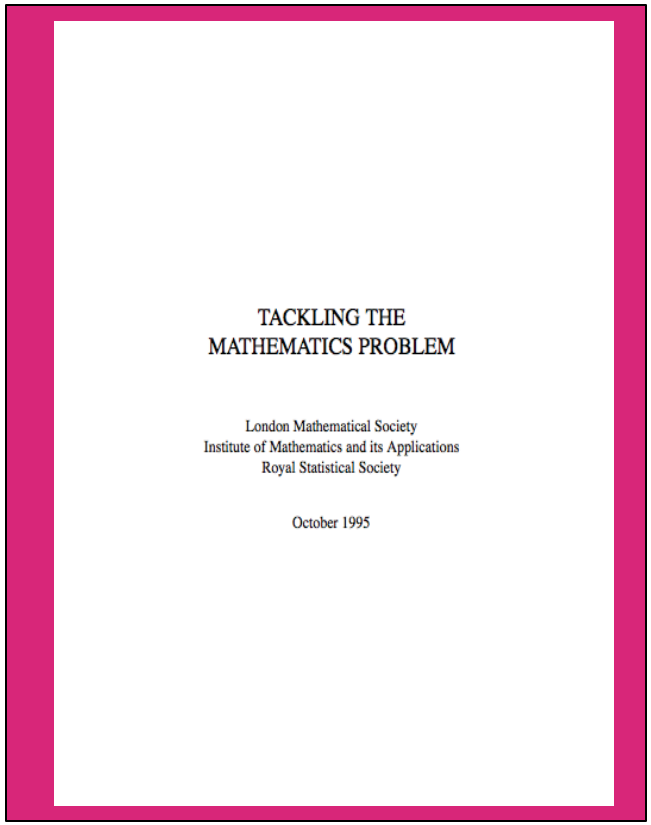
"Over 60 departments of physics engineering and mathematics are now routinely carrying out diagnostic mathematics tests"

The “mathematics problem” – a plethora of reports





The “mathematics problem” – a plethora of reports


TACKLING THE
MATHEMATICS PROBLEM

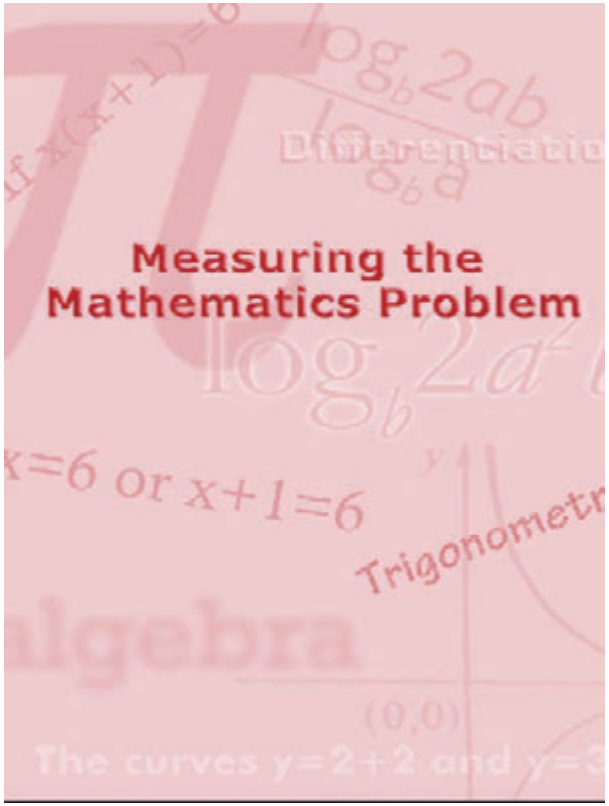
London Mathematical Society
Institute of Mathematics and its Applications
Royal Statistical Society

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

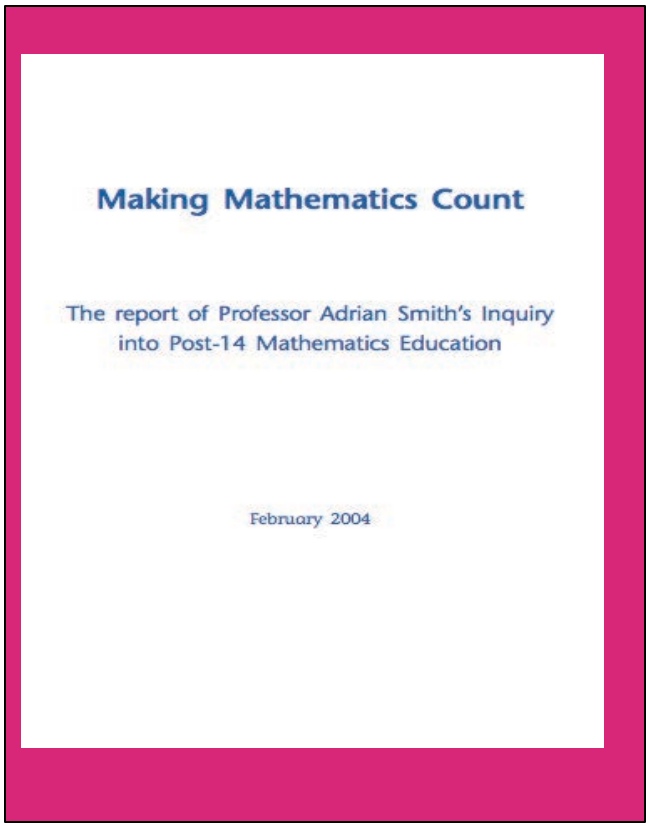


Acute problems now confront those teaching mathematics and mathematics-based modules across the full range of universities…..

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

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14 June 2011 Last updated at 00:02

Universities 'dumbing down on maths' to fill places

COMMENTS (47)

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

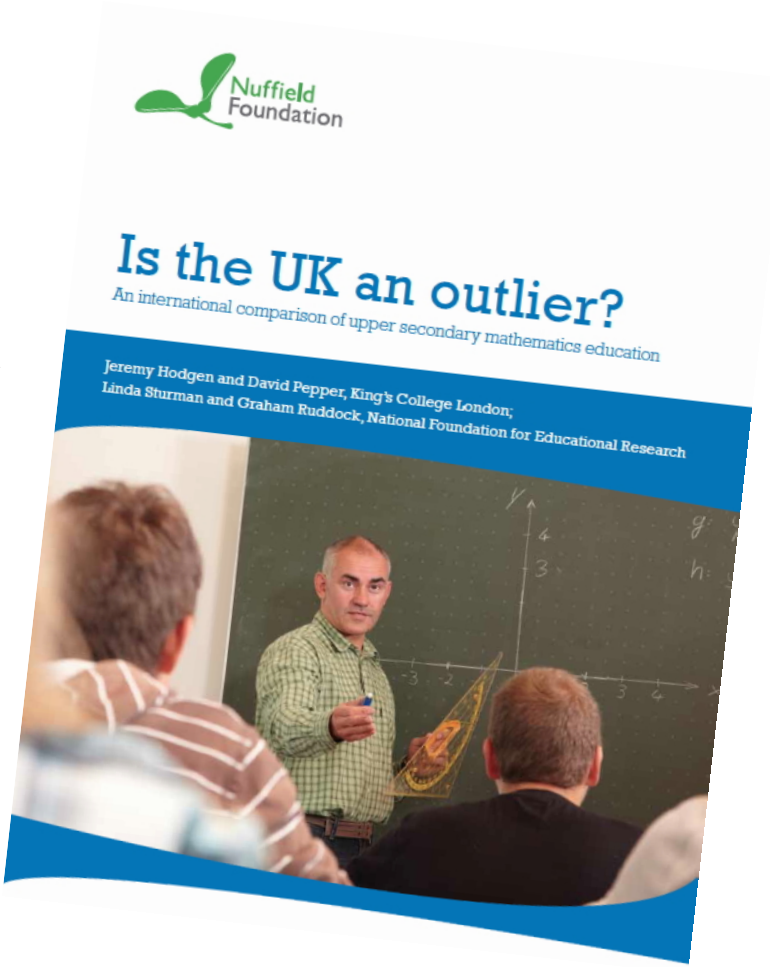
Ministers want students who fail GCSE maths to take it up to the age of 18.

Related Stories

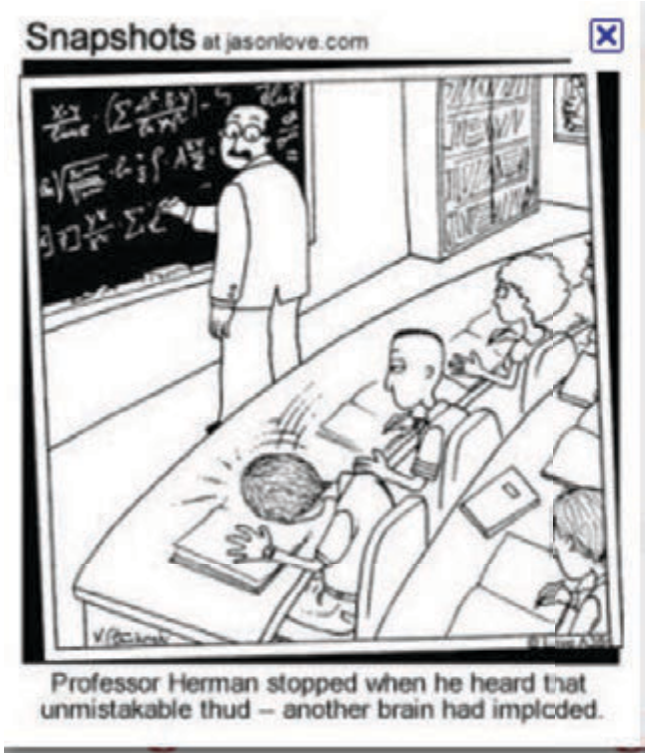
- ACME – Advisory Committee on Mathematics Education – June 2011
- *We estimate that of those entering higher education in any year, some 330,000 would benefit from recent experience of studying some mathematics (including statistics) at a level beyond GCSE.*
- *At the moment fewer than 125,000 have 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

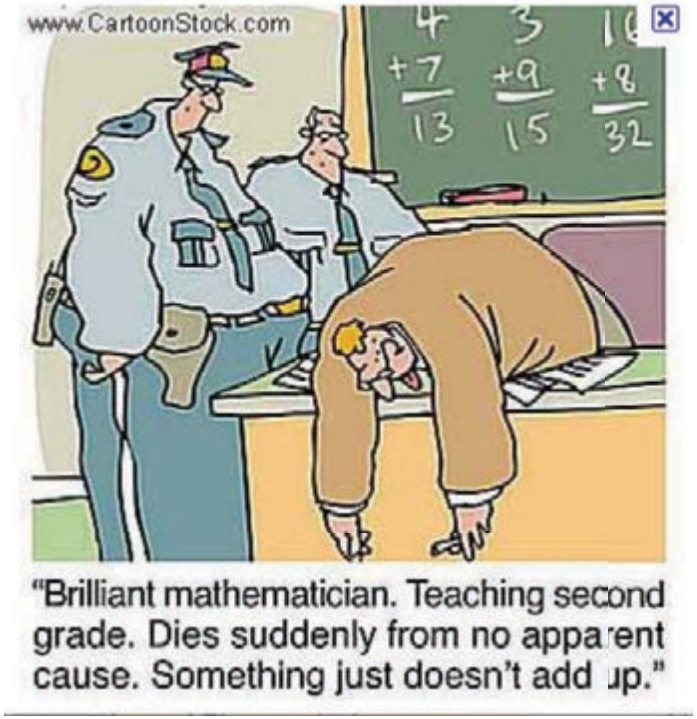
Is the UK an outlier in upper secondary maths education ?

- 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.

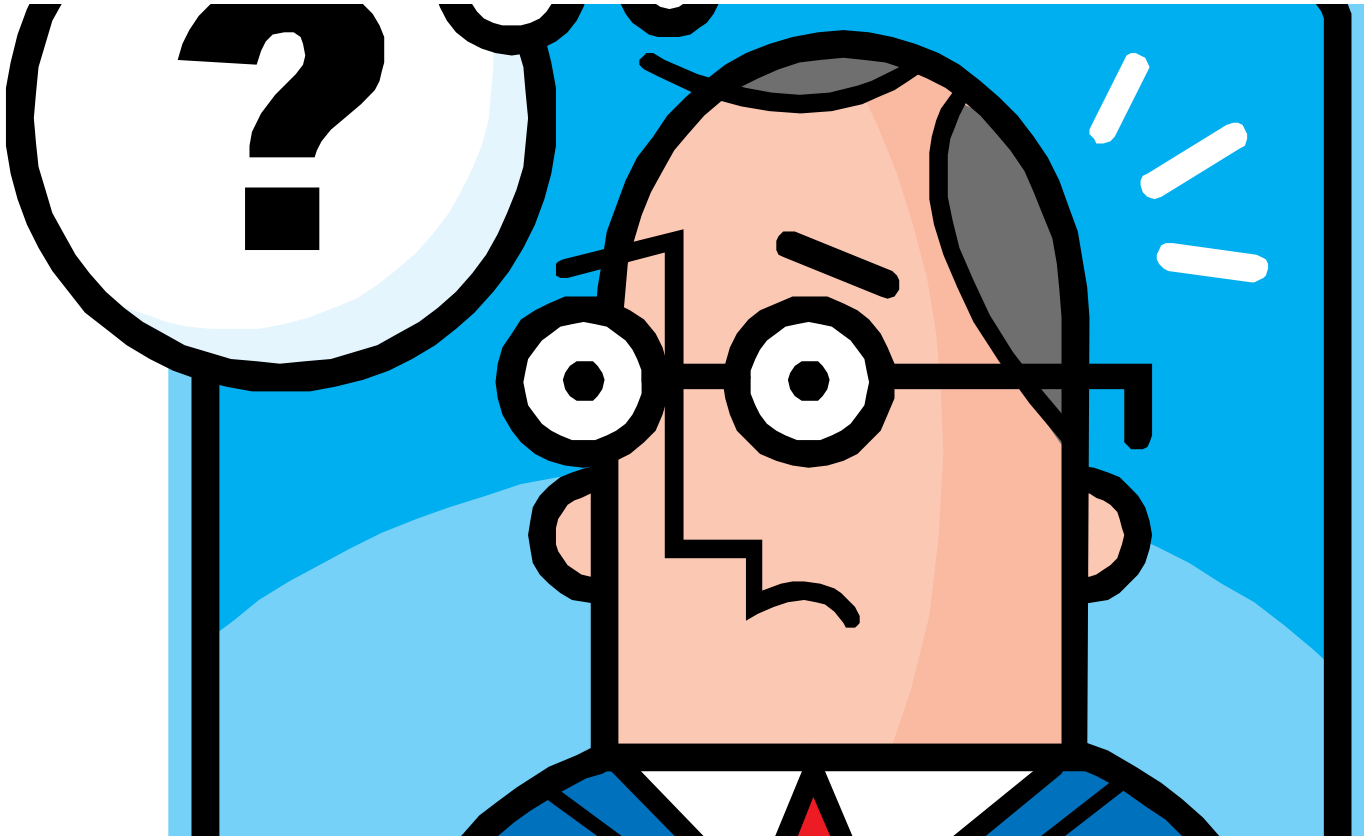


That's the "mathematics problem" !





So what have we been trying to do about it ?

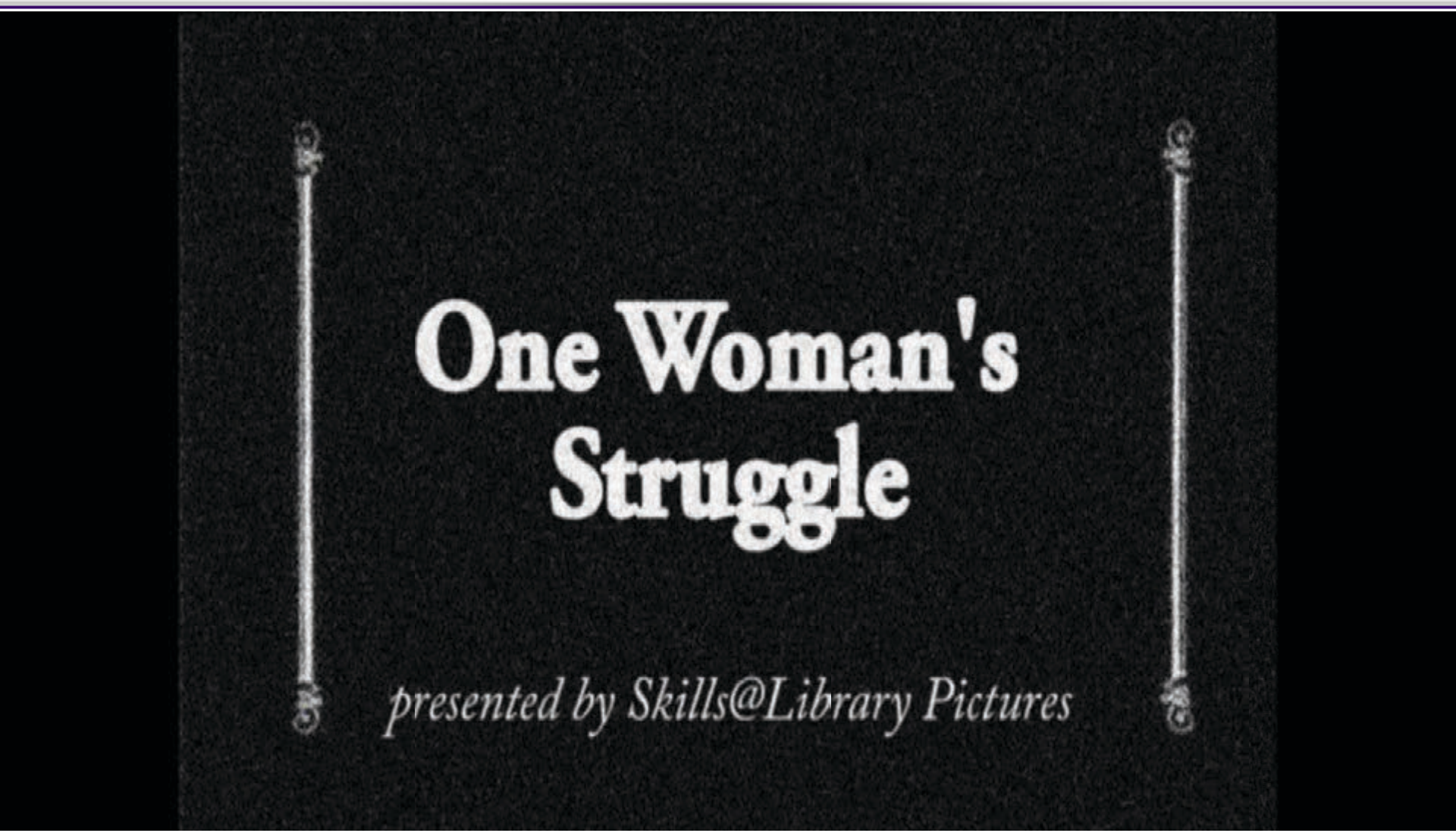


Mathematics support – what is it ?

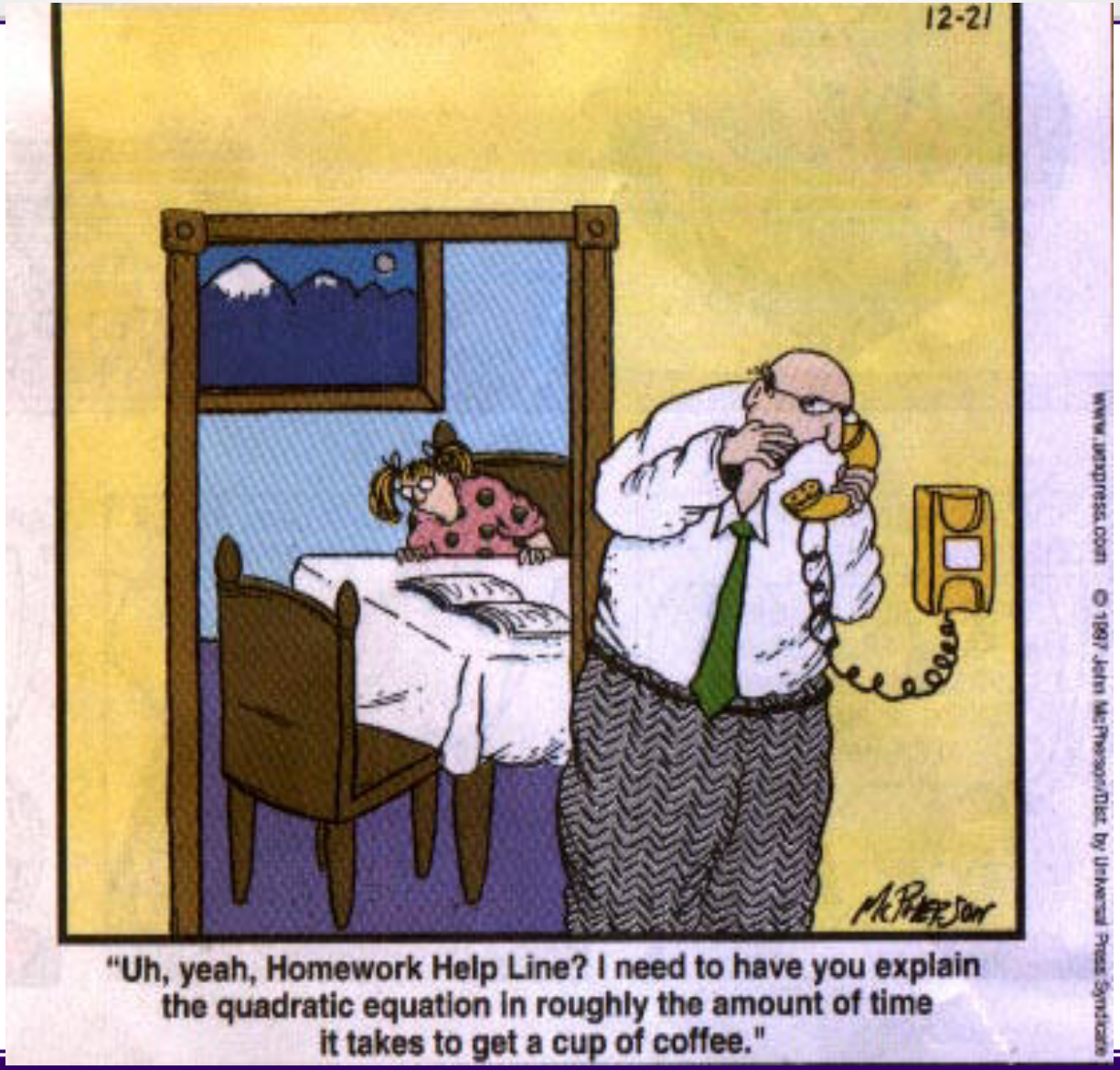
- activities and resources provided to support and enhance students' learning of mathematics and statistics, in any discipline, at any level of higher education and which are provided in addition to traditional lectures, tutorials, examples classes, personal tutorial sessions….

- 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….



Mathematics support – what is it ?



The first Loughborough Centre 1996

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A wealth of maths support resources

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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

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encouraging academics to share maths support resources

Eigenvalues and eigenvectors

mccp-croft-0901 September 9, 2010

Introduction

This lea et 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 λ is an (as yet) unknown number and I is the $n \times n$ identity matrix. For example, if we start with the 2×2 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 simpli ed 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 3×3 matrix the characteristic polynomial will be cubic, and the algebra gets a little more tedious, but the method of calculation is the same.

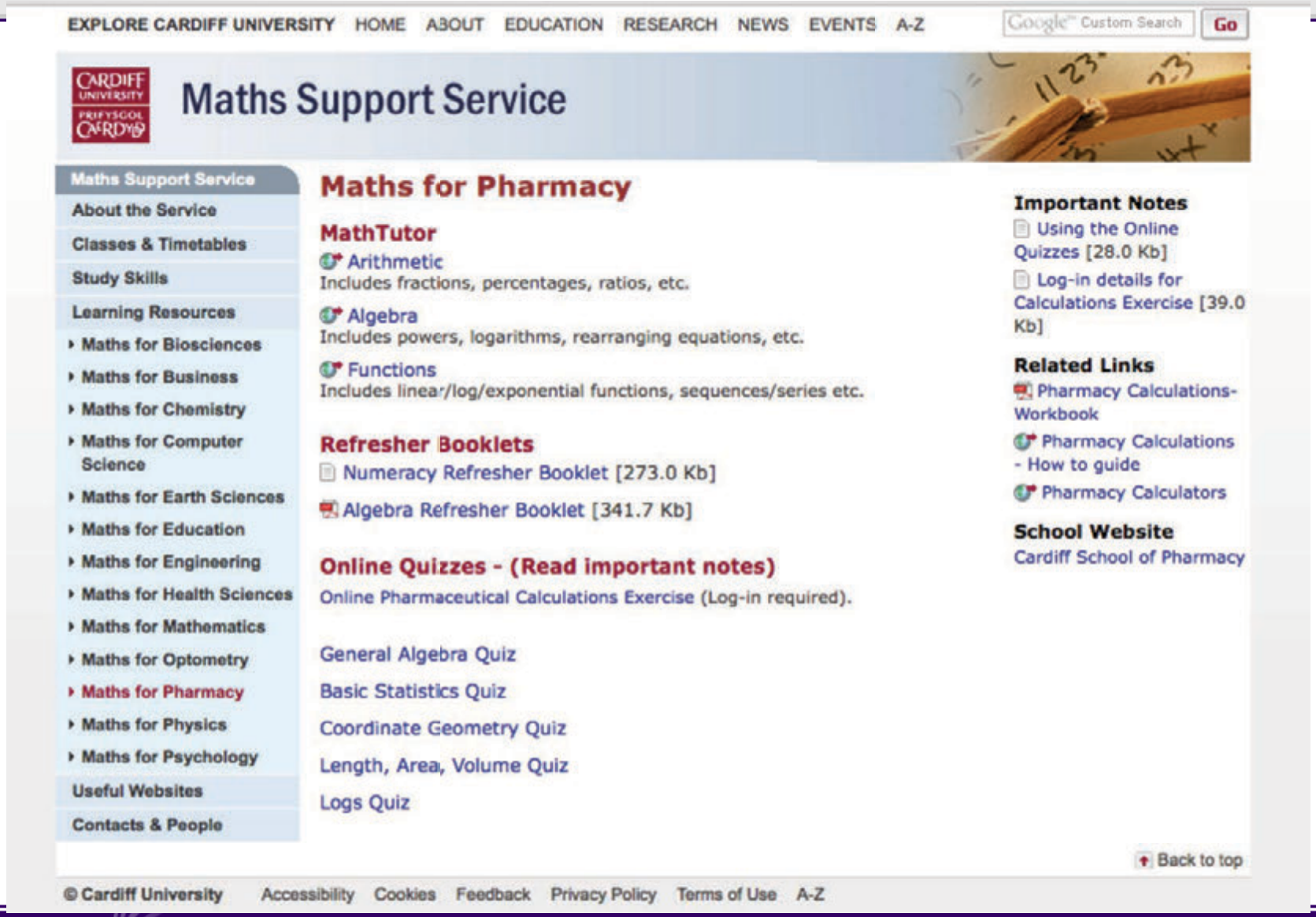
Eigenvalues

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

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

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

Maths support for pharmacists



What maths do pharmacists need ?

This is something I hope to learn more about today:

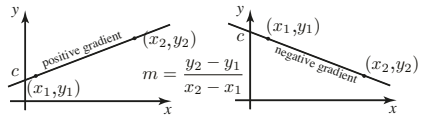
- **? Numeracy: ratios, %, arithmetic, fractions…**
- **? Units of measurement, conversions**
- **? Doses, concentrations, molarity**
- **? Basic algebra: rearranging formulae**
- **? Some common functions and their graphs: logarithm, exponential**
- **? Differential calculus: chemical kinetics**

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

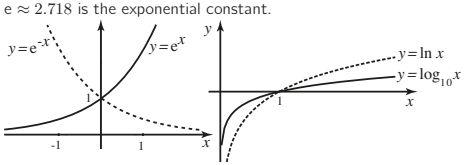
mathcentre has resources to help

Graphs of common functions

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



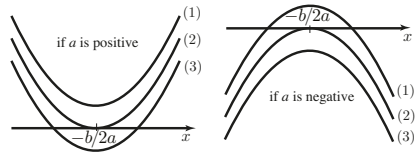
Exponential and log functions:
e ≈ 2.718 is the exponential constant.



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 = μ. Population variance = σ^2. Population standard deviation = σ. Sample values, or **estimates**, are denoted by roman letters.

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

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

The sample mean $\bar{x}$ is an unbiased estimate of the population mean μ. 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

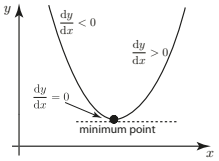
$$s^2 = \frac{1}{n-1}\sum_{i=1}^{n} x_i^2 - \frac{n\bar{x}^2}{n-1}$$

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 $\frac{\sigma}{\sqrt{n}}$, 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:

$$\frac{d}{dx}(u(x) \pm v(x)) = \frac{du}{dx} \pm \frac{dv}{dx} \qquad \frac{d}{dx}(k \times f(x)) = k \times \frac{df}{dx}$$

for k constant.

The product and quotient rules:

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

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

43799 DMS Jan11

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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.

www.**math**centre.ac.uk

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**

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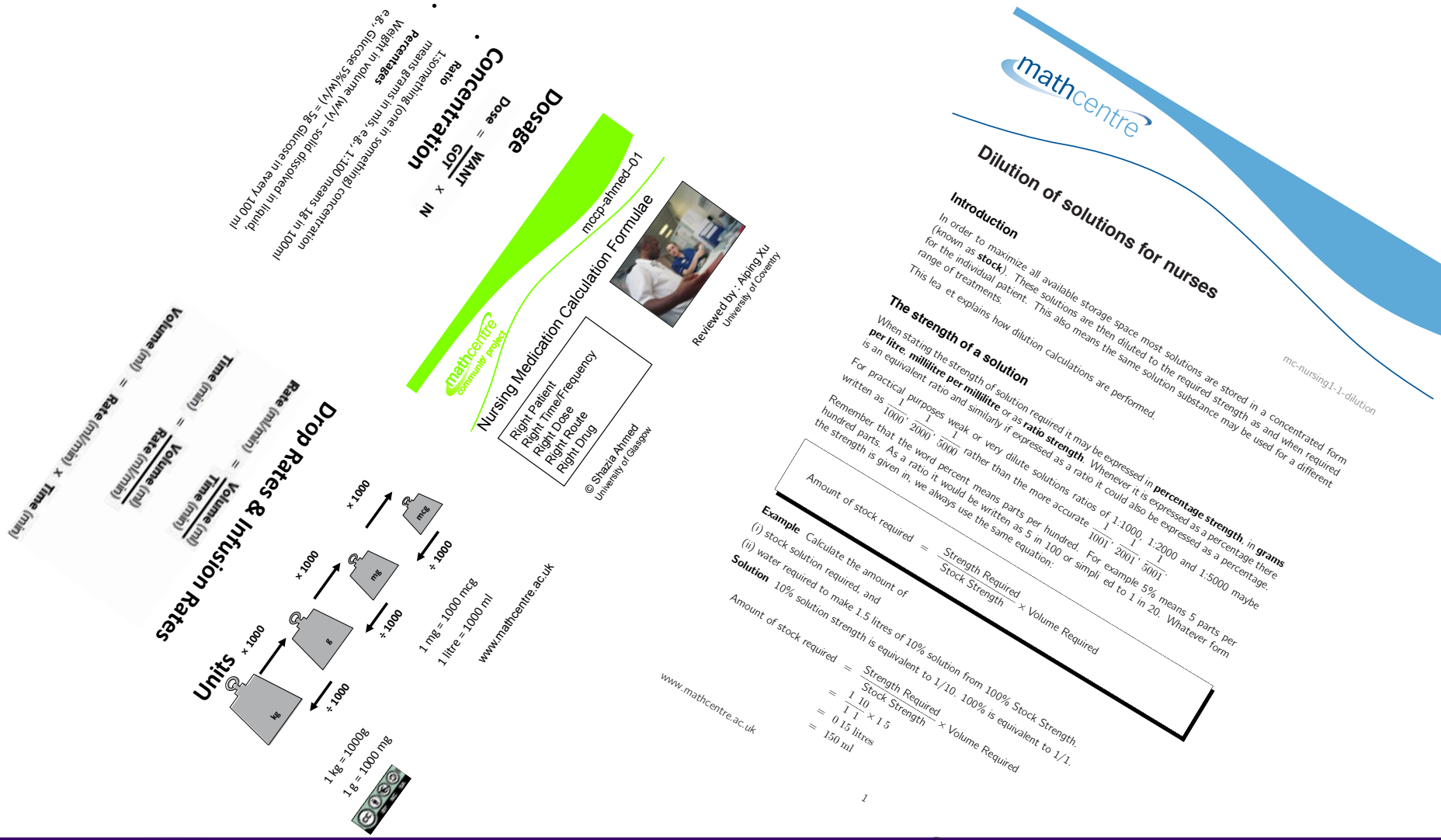
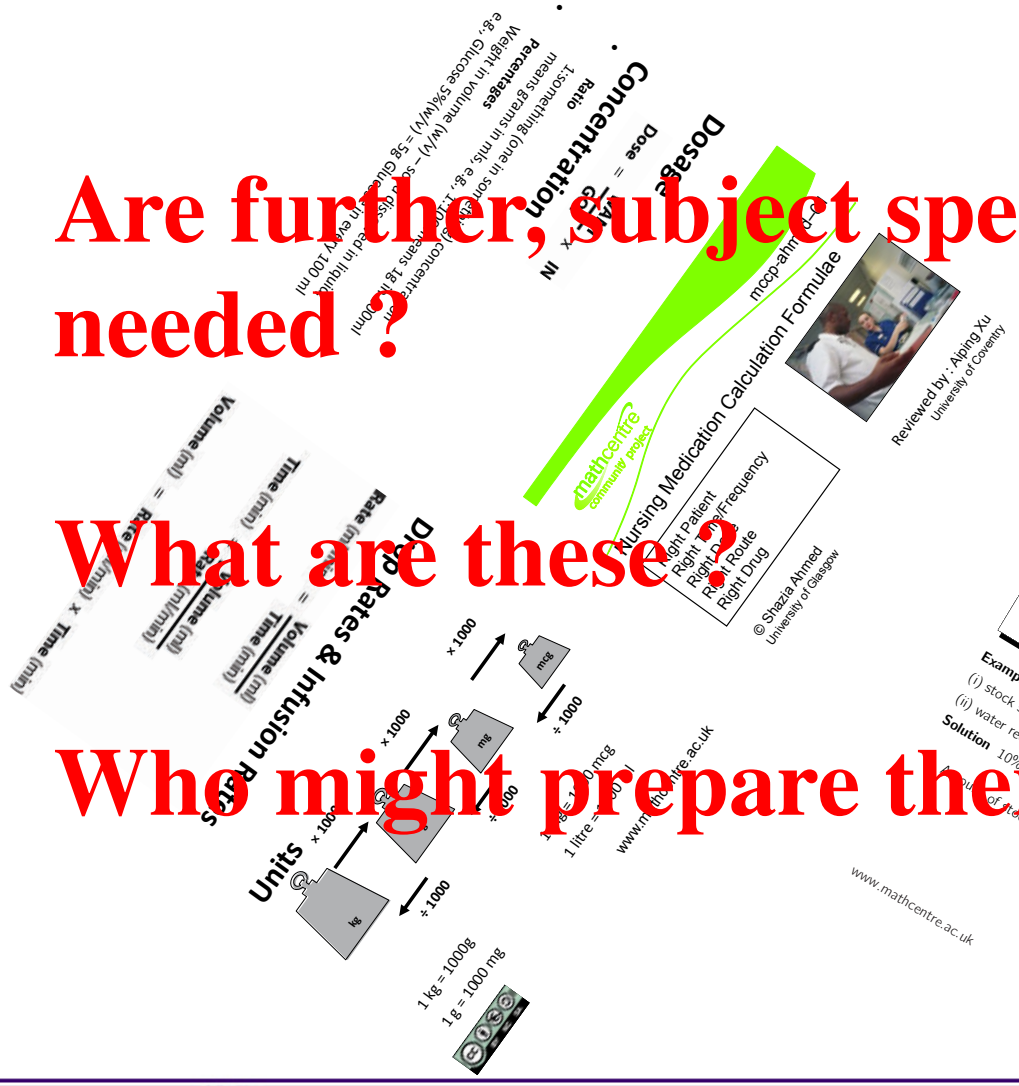


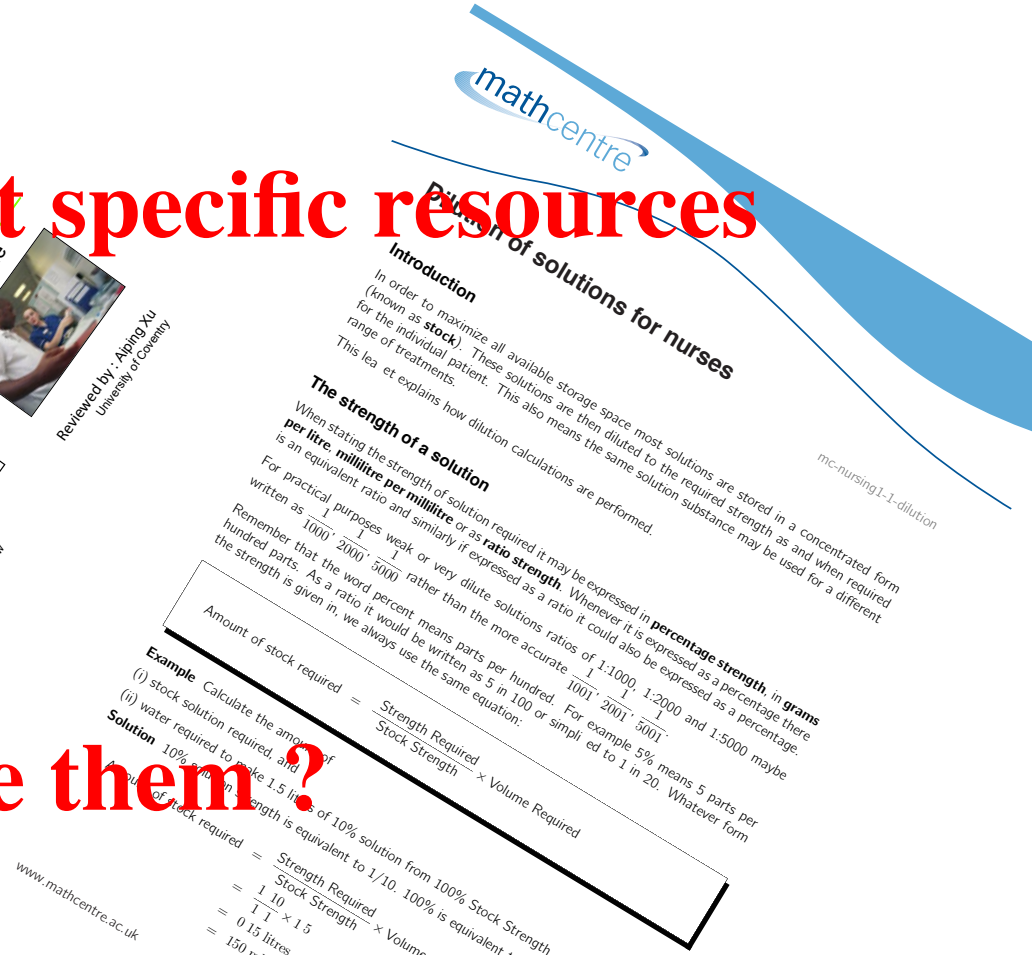
A task for today…..

Are further, subject specific resources needed ?

What are these ?

Who might prepare them ?



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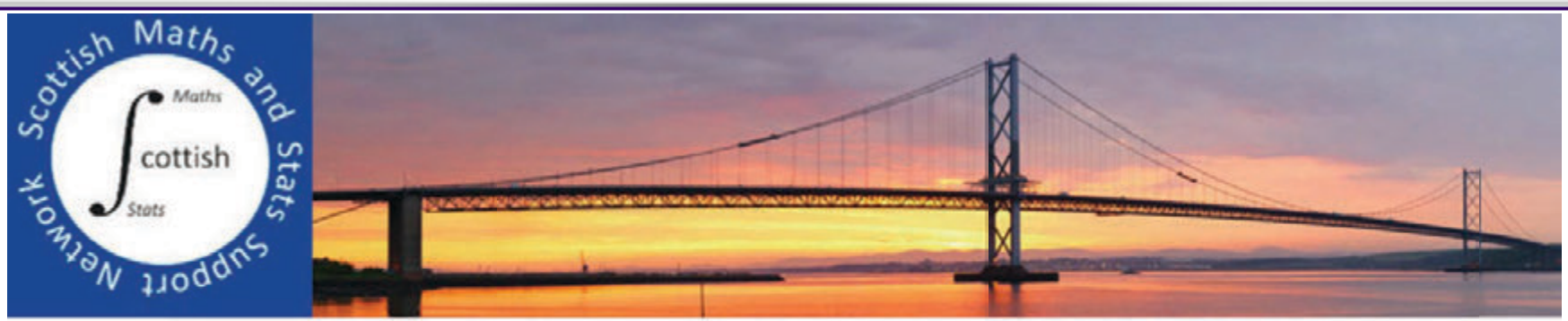

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Scottish Mathematics and Statistics Support Network

centre for excellence sigma Σ in mathematics & statistics support

Welcome

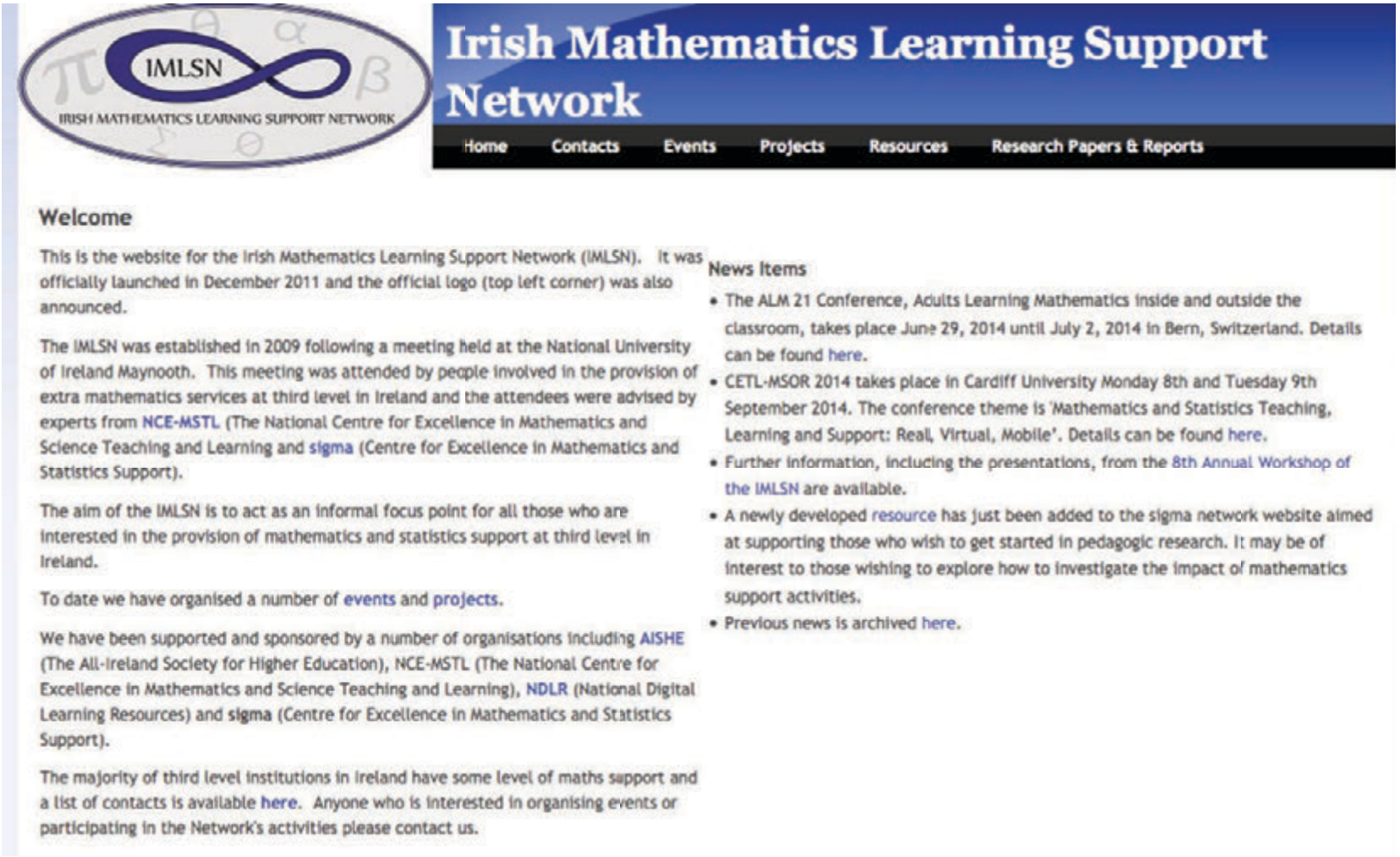
This is the Scottish Mathematics and Statistics Network website; a forum for those interested in the provision of maths support in tertiary education in Scotland.

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



IMLSN

IRISH MATHEMATICS LEARNING SUPPORT NETWORK

Irish Mathematics Learning Support Network

Home | Contacts | Events | Projects | 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 gyd-destun penodol. Fel arfer mae hyn yn golygu *datrys problem*. Mae gweithred neu benderfyniad 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 broblem a cwblhau o leiaf un iteriad arall.

Ystadegau disgrifiadol

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

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

a'r swm sgwariau *cywiriedig* 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 *wyriad sgwâr cymedrig*. Mae $s^2 = \frac{S_{xx}}{(n-1)}$ yn **amcangyfrifyn diduedd** ar gyfer amrywiant y boblogaeth, σ^2. **Gwyriad safonol y sampl** yw s. Wrth gyfrifo s^2, mae'r rhannydd $(n-1)$ 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;
- chwartel isaf (Chl) yw'r $\frac{1}{4}(n+1)$-fed gwerth;
- canolrif (Canol) yw'r gwerth canol [neu'r $\frac{1}{2}(n+1)$ -fed gwerth];
- chwartel 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 bosib eu cynrhychioli â diagram *plot bocs a wisger*, sydd fel arfer yn cael ei alw'n *blot bocs*.

Os yw'r data ar ffurf dosraniad wedi'i grwpio yn ôl amlder lle mae gennym f_i arsylwad mewn cyfwng â chanolbwynt x_i, ac os yw $\sum f_i = n$, yna mae

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

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

Digwyddiadau a thebygolrwyddau

Croestoriad dau ddigwyddiad A a B yw $A \cap B$. *Undeb* A a B yw $A \cup B$. Mae A a B yn **gydanghynhwysol** os na all y ddau gymryd lle ar unwaith, cairf 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 gydanhynhwysol mae

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

Calyntiadau sydd yr un mor debygol

Os yw set gyflawn â n canlyniad elfennol cydd yr un mor debygol o ddigwydd, tebygolrwydd pob canlyniad yw $\frac{1}{n}$. Os yw digwyddiad A yn cynnwys m o'r canlyniadau elfennol 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

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

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

Theorem Cyfanswm Tebygolrwydd

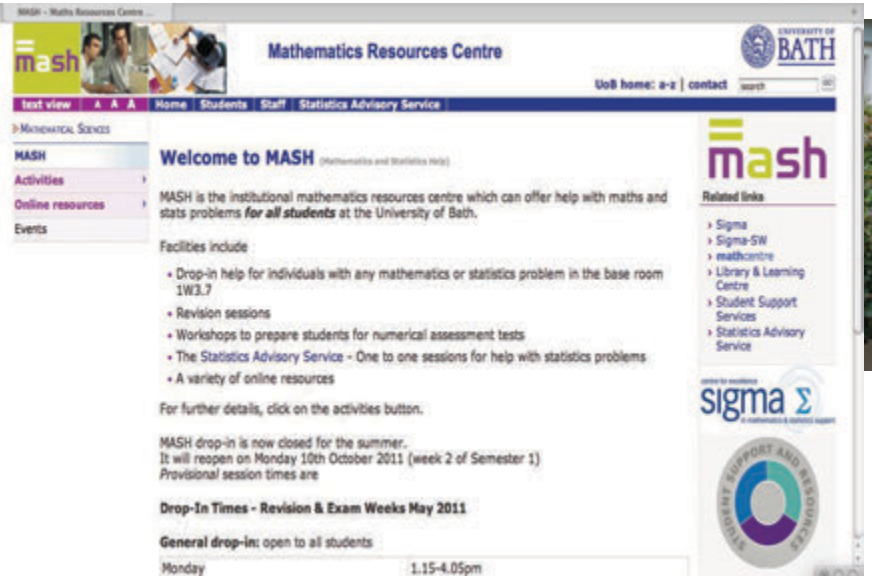
Mae'r k digwyddiad $B_1, B_2, \ldots B_k$ yn ffurfio *rhaniad* o'r gofod sampl S os yw $B_1 \cup B_2 \cup B_3 \ldots \cup B_k = S$ ac ni all dau o'r B_i'au ddigwydd yr un pryd a'u gilydd. Yna mae $P(A) = \sum_i P(A|B_i)P(B_i)$.

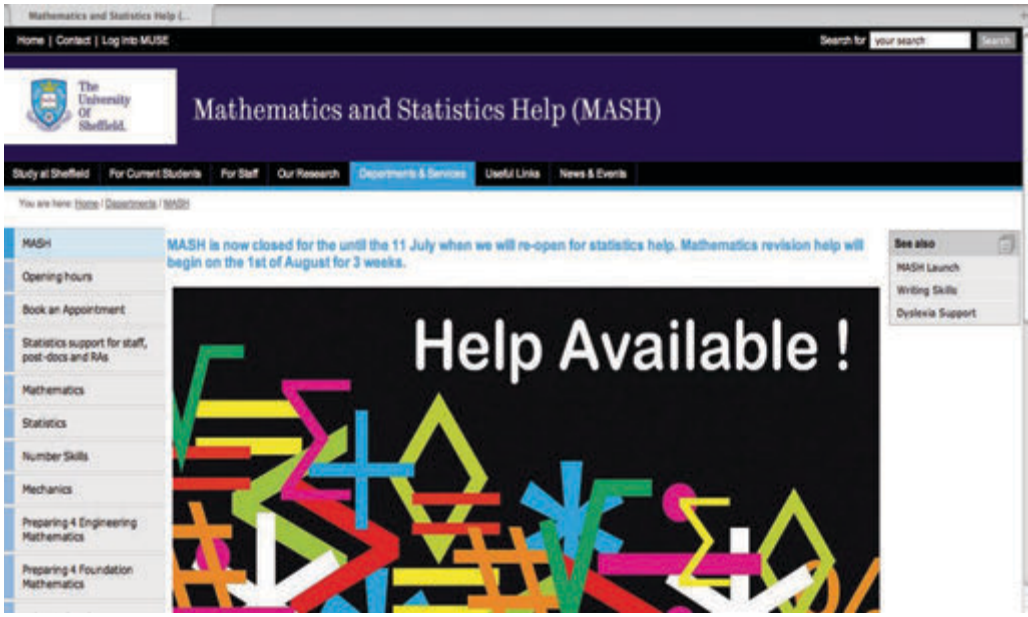
Yn yr achos hwn, gellir cyffredinoli Theorem Bayes i

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

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 achosion arbennig o'r theorem cyfanswm tebygolrwyddau. Mae'n gyffredin i ddynodi cyflenwad y digwyddiad B â $\overline{B}$.

Growth in the number of centres in the UK





Extent of provision

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

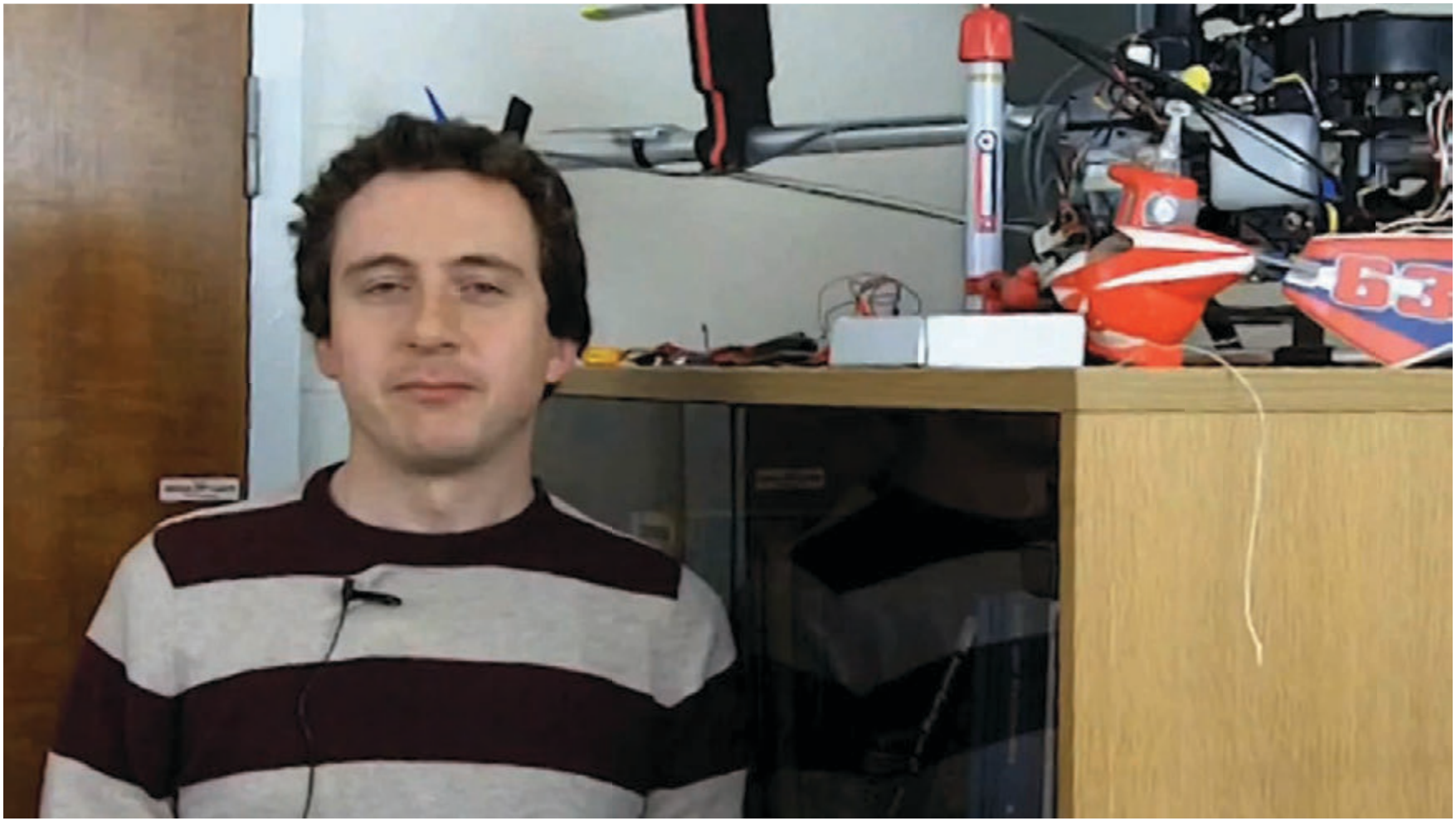
Table 3: Percentage of institutions, by mission group, providing mathematics support

Encouraging and establishing further provision

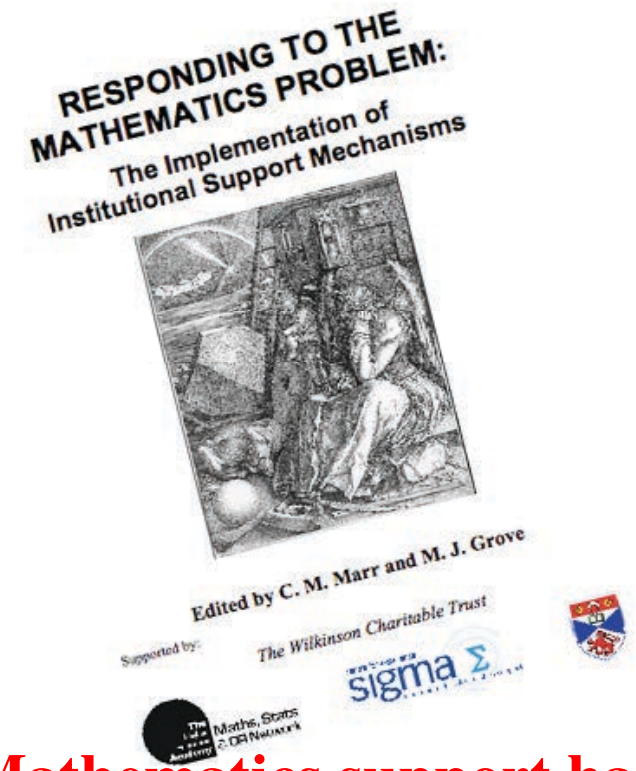
- Maths support at the University of York

  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



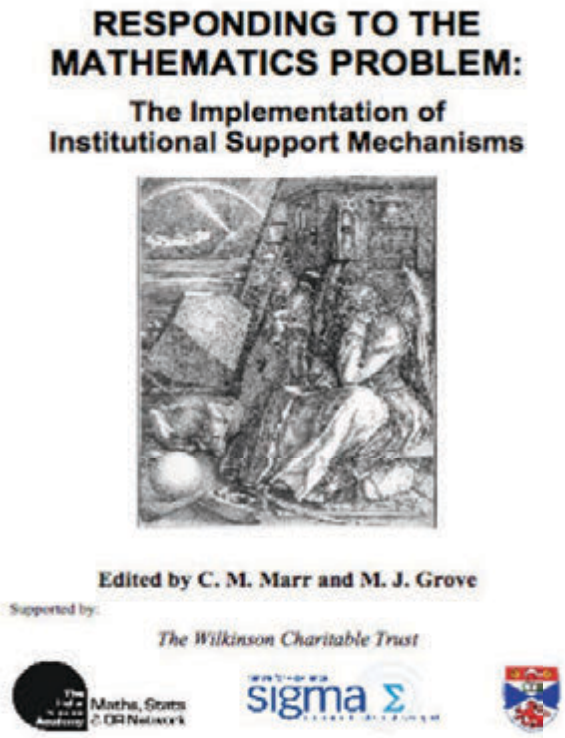
Mathematics support is not the prerogative of the weak!



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.

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

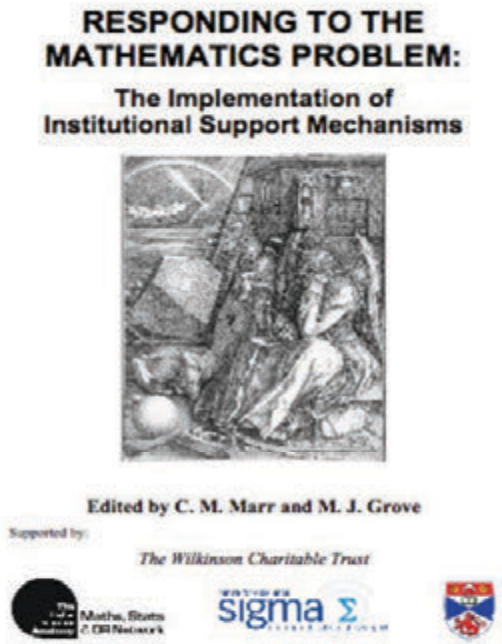
Closing remarks



…..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



…. 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!