



# The Mathematics Support Community of Practice

A report of the achievements of **sigma**  
within the National HE STEM Programme

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# Executive summary

Mathematics underpins all STEM subjects to a significant extent. For many students, difficulties with mathematics and statistics can be a barrier to successful study of a STEM discipline in higher education. One of the key roles of mathematics and statistics support is to enable all STEM students to achieve their full potential in their chosen discipline by helping them to develop confidence, knowledge, skills and understanding in relation to mathematics and statistics.

With funding from the National HE STEM Programme, **sigma** has facilitated the establishment of a vibrant community of mathematics and statistics support practitioners. This community, the **sigma** network, will continue beyond the end of the Programme in July 2012.

There have been two key strands in the development of the community of practice: central activities provided by **sigma** at Coventry and Loughborough Universities and local activities delivered by the **sigma** regional hubs, covering the whole of England and Wales.

The central activities have included:

- The development and sharing of resources and good practice guides;
- Promoting rigorous evaluation through providing workshops, a good practice guide and collating the latest research related to evaluating the effectiveness of mathematics and statistics support;
- Provision of staff development and training;
- An annual conference, attended each year by over 100 delegates;
- Annual **sigma** prizes for an outstanding contributor and a rising star in mathematics and statistics support;
- The **sigma** advisors scheme, whereby experienced practitioners provide advice and mentoring to those embarking on the provision of mathematics support;
- Continuing to host and develop **mathcentre** — an open-access, on-line mathematics support centre providing over one thousand trusted resources for students and academic staff, and containing the **mathcentre** community project.

The role of the six **sigma** regional hubs has been to provide local access to fellow practitioners for the sharing of good practice and advice and for workshops focused on topics of specific relevance to the institutions aligned with the regional hub, such as the provision of statistics support or the numeracy needs of nursing students. Colleagues from over 70 higher education institutions (HEIs) have engaged with regional hub activities.

**sigma** has been able to support directly the establishment of mathematics and statistics support provision at 14 HEIs in England, through the provision of matched funding, and indirectly a further

eight new centres at HEIs in Wales through working with the Wales Spoke of the National HE STEM Programme.

In addition to expanding the community through new centres, as part of the Practice Transfer Adoption scheme within National HE STEM Programme, **sigma** has facilitated specific mathematics and statistics support enhancement projects at six HEIs. These projects have included the commencement of statistics support and the use of student ambassadors to develop the local provision.

The success of **sigma**'s work can be evidenced in a number of ways, including:

- The extent of mathematics and statistics support within the UK HE sector. A recent survey showed that 88 institutions (85% of those replying) now have some form of mathematics and statistics support;
- Staff from 87 HEIs in England and Wales have participated in **sigma** events;
- Explicit reference to mathematics and statistics support in the OFFA Access Agreements of at least 14 English HEIs;
- The unanimous commitment of the regional hub co-ordinators to maintain activity in 2012/13;
- The establishment of a (voluntary) steering group of mathematics and statistics support practitioners to guide and develop the **sigma** network in the future.
- The continuation of the CETL-MSOR conference in 2013.

As the House of Lords report on Higher Education in STEM (House of Lords 2012), published 24 July 2012, has indicated, mathematics remains a major inhibitor to the successful studying of STEM disciplines in HE. The need for mathematics and statistics support is an on-going requirement and the work of **sigma** within the National HE STEM Programme has firmly established a community of practitioners who are equipped to meet this challenge. The enthusiasm of individuals and the mutual support within this community will ensure that some of the activities described in this report are maintained; however further funding is required to build comprehensively on the momentum generated by **sigma** during the last three years.

The full version of the report is available at

<http://tinyurl.com/sigma-Network-full-report>

and

[www.sigma-network.ac.uk/wp-content/uploads/2012/11/The-Maths-Support-Community-of-Practice.pdf](http://www.sigma-network.ac.uk/wp-content/uploads/2012/11/The-Maths-Support-Community-of-Practice.pdf)



# Section 1

## Introduction

The new funding regime in UK higher education places a much greater emphasis on the support offered to students when they are at university. This gives the providers of mathematics and statistics support an exciting opportunity to develop their provision and to embed it in the institutional support structures within their universities. It is an opportune time to reinforce the community of practice for mathematics and statistics support practitioners – a network in which to share experiences and resources, receive guidance and work together for the benefit of the whole student community.

### 1.1 What is mathematics support?

Mathematics Support is a recognised<sup>1</sup> collective term for extra-curricular mathematics and statistics teaching and learning services in higher education institutions (Samuels and Patel 2010). The term covers activities, facilities and/or resources provided to support and enhance students' learning of mathematics or statistics whilst the student is enrolled on a programme of study at undergraduate or postgraduate level. Such learning support is extra, optional, and non-compulsory and is designed to assist students in developing mathematical and/or statistical confidence, knowledge, skills and understanding. Usually, no module credit is associated with a student's engagement with a learning support activity. Sometimes such learning support can be aligned with specific components of their degree course, but its assistance is optional and supplementary (Croft et al. 2011). Samuels and Patel (2010) identify the salient features of mathematics support and position it among the other learning experiences provided for students in higher education institutions (HEIs). There has been a huge growth in mathematics support activity over the last few years as universities have responded to the challenges presented by very diverse student cohorts.

### 1.2 Why mathematics support?

In the UK, in the early 1990s, serious problems were emerging in mathematics, engineering and other departments in universities. There were many reports from professional bodies and research papers which highlighted students lack of basic skills, lack of preparedness in mathematics, high fail-

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<sup>1</sup>The terminology is changing as statistics support grows in importance (See page 49). In this report we will use the term 'mathematics and statistics support' unless the context demands otherwise, in a quotation from another source for example.

ure rates<sup>2</sup>, and low numbers of students wanting to study mathematically-based subjects (Hawkes and Savage 2000). It was in response to these problems that universities began to look into ways of better supporting students with their mathematics. At the time, it became particularly urgent to support students in engineering and as time has gone on so this issue has grown. In recent years clear evidence has emerged that the number of disciplines impacted by the mathematics problem has broadened, from its initial impact upon the disciplines of mathematics, engineering and physics, with issues now being seen within chemistry<sup>3</sup>, and the biological (Koenig 2011), health and social sciences (British Academy 2011, paragraph 23ff).

Since 2000 there have been numerous investigations into and publications on what has become known (Hawkes and Savage 2000) as ‘the maths problem’. In 2004 an influential government report (Smith 2004) reinforced the concerns, finding that, until problems associated with mathematics teaching in schools had been resolved, higher education would have to accommodate students who were inadequately prepared (Croft et al. 2011).

From 2010 onwards a series of national reports highlighted issues relating to mathematics education prior to (and in some cases including) higher education (Advisory Committee on Mathematics Education 2011, Hodgen et al. 2010, House of Lords 2012, Vorderman et al. 2011, Institute of Physics 2011, Nuffield Foundation 2011, SCORE 2011, Royal Society of the Arts, Manufacture and Commerce 2012). Among the conclusions of these reports were:

- “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” (Advisory Committee on Mathematics Education 2011);
- “English universities are side-lining quantitative and mathematical content because students and staff lack the requisite confidence and ability. This has the potential to damage standards in English universities” (Royal Society of the Arts, Manufacture and Commerce 2012);
- The latest of these reports (House of Lords 2012), published on 24 July 2012, exactly a week before the end of the National HE STEM Programme, commented that “the level at which [mathematics] is taught [in schools] does not meet the requirements needed to study STEM subjects at undergraduate level”.

These reports and the on-the-ground experience of those involved in providing mathematics and statistics support helped to identify the key needs to be addressed.

### **1.2.1 What is a mathematics and statistics support centre?**

In 2008, a report from the Public Accounts Committee (Public Accounts Committee 2008) urged universities to improve retention by providing ‘additional academic support for students, for example those struggling with the mathematical elements of their course’.

The establishment of a mathematics and statistics support centre is one way of providing this additional academic support. The term<sup>4</sup> ‘mathematics and statistics support centre’ is usually taken to mean a dedicated, physical space in which to offer mathematics and statistics support.

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<sup>2</sup>In 1998, the Quality Assurance Agency for Higher Education noted the “relatively high failure rates [in Electronic and Electrical Engineering] mainly due to the difficulties students experience in acquiring the essential mathematical skills” (QAA 1998)

<sup>3</sup>For the view of a major employer, see (ABPI 2008, Section 2.2.1).

<sup>4</sup>The terminology varies between institutions and, as statistics support has increased in importance, it has become much more common to include statistics in the title of a support centre.

Tutors are available in the centre at specified times. The centre may be used to house a bank of learning resources so that students are encouraged to help themselves and not rely solely on the intervention of a tutor. Many centres offer students workspace to encourage learning communities. There is often access to computing and other facilities such as video. There is some variation in where support centres are located. They may be in a mathematics (or other) department or in a central service such as a library or skills centre. There are pros and cons whichever location is used. Some centres may employ staff dedicated to offering mathematics support whereas others may make use of mathematics and statistics lecturers and postgraduate tutors.

Mathematics and statistics support centres are a relatively new phenomenon – in the 1980s it would be hard to find a mathematics (still less statistics) support centre in a British university. The innovations that **sigma** has brought about over the past seven years have played a large part in transforming this — now it is the norm for an HEI to have one (Perkin et al. 2012). Although initially many support centres were set up to assist struggling students who were in danger of failing, over the years their remit has expanded and they now provide support to many students who are doing well but want to do even better. A description of a typical support service based in a support centre and some of the issues encountered can be found in (Wilson and Gillard 2008).

### 1.2.2 Who benefits from mathematics and statistics support?

Students are the primary stakeholders in mathematics and statistics support activities. Improving their university experience and their understanding of the mathematics and statistics they need for success in their courses is an important objective for all those who work in support centres. During difficult times for mathematics education in general, where negative attitudes are commonly reported on, it is notable that student evaluations on mathematics and statistics support frequently report positive attitudes towards the subject, students are more enthusiastic about mathematics and statistics, more confident in their abilities and they often report on the friendly and enjoyable atmosphere that mathematics and statistics support centres provide as the norm. Evaluations (Mac an Bhaird et al. 2009, Pell and Croft 2008) also highlight improved performance leading to increasing retention and progression rates as students increasingly make use of whatever mathematics and statistics support is available.

## 1.3 Background to sigma

In 1991, with funding from British Petroleum, Coventry University established the BP Mathematics Centre to enable early identification of student problems and to provide on-going support. In 1996, following a visit to Coventry, colleagues from Loughborough set up the Mathematics Learning Support Centre based on the Coventry model.

In 2005 the Higher Education Funding Council for England (HEFCE) launched the Centres for Excellence in Teaching and Learning (CETL) initiative. The collaborative work at Loughborough and Coventry Universities in mathematics support was recognised as a Centre for Excellence and the **sigma** Centre for Excellence in University-wide mathematics and statistics support was formally created.

In addition to its work within the host universities, **sigma** was one of the most outward facing CETLs and provided funding to help establish mathematics support centres in other institutions and worked closely with the MSOR Subject Centre of the Higher Education Academy, to institute the annual CETL-MSOR<sup>5</sup> conference (see Section 2.2).

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<sup>5</sup>Continuing Excellence in Teaching and Learning in Mathematics, Statistics and Operational Research

Following on from the success of the **sigma** CETL programme, the **sigma** network was officially launched in July 2010. Funded through the National HE STEM Programme and part of the Mathematical Sciences strand managed by the Institute of Mathematics and its Applications (IMA), the **sigma** network has focused on disseminating good practice and information and stimulating the wider development of mathematics and statistics support provision based upon collaboration and the sharing of ideas. These are key elements of the CETL programme which continued and were developed further under the **sigma** network, including the provision of pump-priming funding to universities to stimulate the development of mathematics and statistics support within their institutions, the widening of the regional hub pilot scheme to cover all of England and Wales and continued support for the annual CETL-MSOR conference. In addition, the **sigma** award scheme for outstanding contribution to the field of mathematics and statistics support has continued so that the commitment and dedication of colleagues in this important field can be recognised.

As well as continuing previous good practice, the **sigma** network has sought to provide as much strategic support to the community as possible. To this end, a feedback framework that can be used by the community has been developed; a training course for postgraduate students who provide mathematics and statistics support has been organised and delivered; a resource development workshop has been held to provide colleagues with dedicated time and space to develop resources for use by the whole community; and an innovative project to support part-time students in their workplace piloted. For further details please see Section 2.

## 1.4 Aims of the National HE STEM Programme funding

Since its inception as a Centre for Excellence for Teaching and Learning (CETL) in 2005, **sigma** has had a clear vision and strategy to disseminate its experience and good practice as widely as possible in the higher education sector, a process greatly enhanced by the National HE STEM Programme funding received in 2010. The formal aims of the Student Support/Transition substrand of the National HE STEM Programme funding for mathematics were:

1. Establish the **sigma** Mathematics Support Network, a free association of staff and institutions providing mathematics support who work together to share resources and experience;
2. Develop two central hubs (at Coventry and Loughborough Universities) to co-ordinate the **sigma** Mathematics Support Network;
3. Set up 6 **sigma** regional hubs which will:
  - identify their local constituency;
  - promote and host at least 2 local events per year;
  - gather, analyse and report evaluation data;
  - provide updates for the Network website;
  - report in the e-newsletter;
  - contribute to the annual conference.
4. Organise, in conjunction with the MSOR Subject Centre of the Higher Education Academy, an annual conference on mathematics support;
5. Work with the officers of the Mathematical Sciences Societies Unit to develop and pilot mathematics support for learners in the work-force;

6. Work with other discipline communities to provide subject-specific mathematics support resources;
7. Organise a competitive process for distributing funds to create mathematics support provision at HEIs in England and Wales, which have currently little or no mathematics support.

As the National HE STEM Programme progressed, it became clear that the development of a mathematics and statistics support community was one of its most important and most successful activities affecting, as it does, all STEM disciplines. Consequently, when the Programme initiated its Practice Transfer Adopters scheme, it was natural that **sigma** should be asked to contribute. The activity that HEIs could choose to 'adopt' was *Enhancing a Mathematics Support Provision*. Late in 2011, the Programme Executive re-profiled the budget to release additional funding to those parts of the Programme that were identified as having the most impact. A considerable amount of additional funding was made available to **sigma** to organise an additional round of funding to create new mathematics and statistics support provision (as had already been completed in fulfilment of Aim 7).

## 1.5 Structure of the report

As indicated in the title of this report, its focus is on the development of a mathematics support community of practice — the **sigma** Mathematics Support Network referred to in Aim 1. Section 2 focuses on the role played by the central hubs at Coventry and Loughborough Universities in developing, maintaining and expanding that community through the dissemination of their expertise. This addresses Aims 2 and 4–6. Section 3 highlights the crucial role played by the regional hubs (Aim 3) whilst Sections 4 and 5 cover the originally planned new centres (Aim 7) and the additional new centres and enhancement projects (additional aims developed during the Programme, see above). Evaluation of the **sigma** network and its impact on practice and policy within HEIs is discussed in Section 6.

Sustainability of the innovations brought about by the National HE STEM Programme funding is important and potentially problematic. Consideration is given to the steps taken during the project to ensure this. It is gratifying to report that the community created by **sigma** has firm plans to continue into the forthcoming academic year and beyond. The plans for sustainability are brought together in Section 6.

A key management tool for the directors of **sigma** was the operational plan which enabled subsidiary aims and objectives to be identified and progress towards them recorded. At the outset of the National HE STEM Programme in 2010 this identified 13 such subsidiary aims; the additional funding received in 2011 brought with it another seven. The main part of this report is, implicitly, a detailed examination of the outcomes in each of the 20 areas. The broad conclusion is that in 18 of the 20 areas the aims were met and in several instances significantly exceeded. The difficulties encountered in the other two areas are analysed in some detail and suggestions made as to how these aims, which remain valuable and important, might be achieved in the future.

## 1.6 Acknowledgements

The author acknowledges, with gratitude and pleasure, that this report is heavily reliant on material originally written by others involved in the **sigma** network project, in the form of internal reports or as contributions to other **sigma** publications. He hopes the originators will feel their material has been used appropriately in recounting the outcomes of a very successful project.

## Section 2

# Creating a community of practice: the role of the central hubs

Everything in this report is underpinned by the experience and expertise of staff at Coventry and Loughborough Universities who have pioneered mathematics and statistics support for more than 20 years. Their pre-eminence was confirmed when, at the Times Higher Awards ceremony on 24 November 2011, it was announced that Loughborough and Coventry Universities had won the award for Outstanding Support for Students, in recognition of the work of **sigma**, Centre for Excellence in University-wide Mathematics and Statistics Support. The judges' citation given by Liam Burns, President of the National Union of Students stated:

**sigma** is a fantastic example of institutions recognising genuine concerns in standards and acting in a positive way to address them. Students' reports about the support they received were exceptionally positive. Loughborough and Coventry should be incredibly proud of delivering support for students in a positive, innovative and transferable way.

Whilst **sigma** at Coventry and Loughborough Universities received the award, the real winner was mathematics and statistics support across the country (Mac an Bhaird and Lawson 2012). **sigma**'s work has contributed to the growing recognition of the importance of mathematics and statistics support and to the early stages in the development of a national and international community of practitioners. It was natural then that, being the intellectual centre of the embryo community of practice in mathematics and statistics support, Coventry and Loughborough Universities should also be at the organisational centre of **sigma** within the National HE STEM Programme. Formally, the project plan sought to

Develop two central hubs (at Coventry and Loughborough Universities) to co-ordinate the **sigma** Mathematics Support Network.

### 2.1 Outcomes

Since its inception in 2005, **sigma** has had a clear vision and strategy to disseminate its experience and good practice as widely as possible in the higher education sector. The Central Hubs, at Coventry and Loughborough Universities, used the National HE STEM Programme funding to organise and promote national events to support members of the network, while the regional hubs (see Section 3) organised and promoted local events. The remainder of this section provides more details of the work carried out at national level.

## 2.2 CETL-MSOR conferences

The first CETL-MSOR conference took place in 2006 at Loughborough University organised by **sigma** in collaboration with the MSOR Subject Centre of the Higher Education Academy. Since then it has taken place annually, being hosted by a variety of institutions (Birmingham (twice), Lancaster, Coventry, Sheffield and the Open Universities). The aim of the conference is to promote, explore and disseminate emerging good practice and research findings in mathematics and statistics support, learning, teaching, and assessment.

The conference has been identified by practitioners as playing a crucial role in the development of mathematics and statistics support. It allows individuals, regional hub members and colleagues from the UK and further afield to share their experiences, discuss issues or interventions that they have trialled. The edited proceedings<sup>1</sup> are an invaluable source of advice, innovations and ideas for people who are considering a review of existing mathematics and statistics support arrangements or the establishment of new support services.

### 2.2.1 The CETL-MSOR conferences 2010–2012

The CETL-MSOR conference is now firmly established as the UK's premier event for those concerned with the scholarship of learning and teaching of mathematical sciences in higher education. The 2010 Conference took place at the University of Birmingham on 6 & 7 September with 105 delegates attending. The 2011 Conference was held at Coventry University on 5 & 6 September and attracted 107 attendees.

The 2012 Conference, held at the University of Sheffield and sponsored by the Higher Education Academy, attracted 110 delegates. It was the main event showcasing to the mathematics and statistics community the work carried out by **sigma** and the Mathematics Curriculum Innovation Projects supported by the National HE STEM Programme.

### 2.2.2 Future CETL-MSOR conferences

The CETL-MSOR conference has been identified by the newly-formed **sigma** network steering committee as the most important activity to preserve for the future. Coventry University has agreed to host the conference in 2013 and to provide some administrative assistance with its organisation.

## 2.3 sigma prizes

In 2009, **sigma** launched the annual **sigma** network prizes for outstanding contributions by individuals (in UK HEIs or from overseas) in the field of mathematics and statistics support. The two annual prizes are the Outstanding Contributor and Rising Star awards.

The Outstanding Contributor award is for a sustained contribution to mathematics and/or statistics support over a period of at least five years, and the Rising Star for notable contributions to mathematics and/or statistics support at an early stage of a career. The prizes allow the wider community to celebrate the achievements and contributions of their peers in mathematics and statistics support. They are also a vehicle through which the importance of this work is highlighted within institutional hierarchies.

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<sup>1</sup>available at <http://www.mathstore.ac.uk/?q=node/2049>

Year	Outstanding Contributor	Rising Star
2009	Chetna Patel University of Sheffield Jan Robertson De Montfort University (shared)	Not awarded
2010	Christie Marr St Andrews University	Ciarán Mac an Bhaird NUI Maynooth
2011	Liz Meenan University of Leeds	Inna Namestnikova Brunel University
2012	Rob Wilson Cardiff University	Not awarded

## 2.4 sigma advisors

With the mathematics and statistics support community expanding to include those with little or no previous experience of mathematics and statistics support, it was decided that support needed to be made available to project leaders. Earlier experience within **sigma** in working with funded centres during the period of CETL funding suggested that a mentoring approach supported by centrally organised workshops would be the most beneficial approach. This level of support could not be delivered by the existing **sigma** team. Accordingly, an open call was made for experienced mathematics and statistics support practitioners to act as **sigma** advisors. This aroused considerable interest and following a selection process 24 potential advisors were recruited. During the recruitment process advisors had been asked to identify their specific areas of expertise; this enabled an effective matching of advisors to new centres and enhancement projects to take place. The mentoring provided by the **sigma** advisors helped to facilitate the successful transfer of existing good practice and of the numerous innovations resulting from the National HE STEM Programme funding of the **sigma** network.

### 2.4.1 sigma fellows

In early 2012 as the end of the National HE STEM Programme approached, it became clear to the **sigma** team that an exceptionally rich range of expertise and experience had been gathered by those involved in the **sigma** network and this needed cataloguing and recording. Accordingly two **sigma** Visiting Fellows — Dr Ciarán Mac an Bhaird of the National University of Ireland, Maynooth and Dr Leslie Fletcher of Liverpool John Moores University — were appointed to help with the task of collating and documenting this and made significant contributions in the last three months of National HE STEM Programme funding.

## 2.5 Workshops

Recognising the breadth of expertise within the **sigma** network as a whole, the Central Hubs have brought together practitioners to reflect on their experience to provide help and guidance to the network as a whole.

### 2.5.1 Postgraduate training workshops

Increasingly, support centres are employing postgraduate students to offer one-to-one and small group help to students who drop in for assistance. **sigma** has offered a one-day workshop for these postgraduates that reflects the differences between the help provided in support centres and that provided in traditional tutorials for which the postgraduates may have already had some training<sup>2</sup>. The workshop was successfully run at Loughborough University in November 2010 with 12 delegates and at Cardiff University in February 2011 with 20 delegates. As there was a clear demand for this type of provision within the community, the delivery team produced a good practice booklet that can be used by others to run similar workshops (Croft et al. 2011). Following the establishment of eight new centres in Wales (see Section 4.4) the Wales Spoke of the National HE STEM Programme requested **sigma** to provide the necessary staff development. Accordingly, training sessions based on the newly-produced booklet were provided by **sigma** advisors at Bangor, Cardiff and Swansea Universities, with 25, 21 and 14 attendees respectively.

A 'Train the Trainers' version of this workshop held at Birmingham University in July 2012 considered how the quality of such training can be assured within institutions and to external agencies such as QAA. As so many HEIs now have mathematics and statistics support services making use of postgraduate students, further advice and a protocol on this are being considered (Croft 2012). This meeting also heard about an innovative scheme developed in the Mathematics and Statistics Support Centre at Cardiff University whereby postgraduates are encouraged to reflect on their practice and use this reflection as part of an application for recognition as an Associate Fellow of the HEA.

### 2.5.2 Evaluating the effectiveness of mathematics support

A well-attended workshop was held on the 11 February 2011 — 19 registered delegates — to discuss the challenges in measuring the effectiveness of support provisions. As a result of this **sigma** created a working group to investigate the development of a common approach to measuring the effectiveness of support services that could be used by the community. The first stage of this process was the collation of evaluation questionnaires from centres across the country. A report resulting from this work (Croft and Green 2012) was published in February 2012 as a printed document and on the **mathcentre** website. A wider literature review is reported in Section 2.6.2.

### 2.5.3 Resource development workshop

A three day resource development workshop was held at Coventry between 28 and 30 June 2011. Eight delegates worked together in pairs based on their interests, producing resources that had been planned in advance. Those attending found the dedicated time and space invaluable in translating their ideas into usable resources. Peer review is currently underway of all resources developed at the workshop and these will be made available more widely through the **mathcentre** Community Project<sup>3</sup>.

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<sup>2</sup>The MSOR Subject Centre of the Higher Education Academy has provided such training for many years; see <http://www.mathstore.ac.uk/?q=node/132> for further details.

<sup>3</sup>[www.mathcentre.ac.uk/communities](http://www.mathcentre.ac.uk/communities)

## 2.6 Publications

A variety of publications has been produced in the form of handbooks for use by mathematics and statistics support practitioners. The workshops mentioned in Section 2.5 have resulted in publications and two larger scale survey projects have produced extremely valuable reviews of current provision and practice. Conference presentations on many of these have been made and peer-reviewed contributions to professional and learned journals are in preparation.

### 2.6.1 More than the sum of the parts

This booklet, produced in 2011, surveyed the contribution made by **sigma** at the half-way stage of the National HE STEM Programme funding.

### 2.6.2 Literature survey

Over the past couple of decades mathematics support provision has developed significantly in UK universities and beyond. It is important that centres are able to demonstrate their effectiveness in supporting students. More rigorous evaluation than the traditional 'happy sheets' is required. Mathematics and statistics support professionals need to know which support strategies work and which do not.

Research publications into the effectiveness of mathematics and statistics support that are known about by **sigma** are linked to from the **mathcentre** website, but hitherto no systematic attempt has been made to collate all the evidence available in the UK and from around the world. This is information that the **sigma** network ought to hold and share on behalf of the community.

The project undertook an extensive literature review to find published work concerning the effectiveness and impact of mathematics and statistics support. The **mathcentre** website list of publications, papers in the CETL-MSOR Proceedings over the last seven years, papers in journals such as *Teaching Mathematics & Its Applications* and the *International Journal of Mathematical Education in Science and Technology* and a small number of PhD theses were the starting points of the literature review. A systematic trawl of these sources was made before widening the search using educational and other databases and known contacts. The project has worked closely with a related project being undertaken on the extent of current provision (see 2.6.3).

Sorting and categorisation of the research papers or studies found has been undertaken together with a critical review to illustrate the range of studies that has been published to-date, their strengths and their weaknesses. Some studies are entirely qualitative, others are quantitative and others have mixed methodologies. Some look at the effects of mathematics and statistics support on factors such as retention and progression, whereas others take a much broader view and cover aspects such as general improvements of the student support infrastructure, improvements to student satisfaction and well-being, catalysing changes in the teaching and learning of mathematics and statistics at university level &c.

The findings were reported in a Project Report (Matthews et al. 2012) and a presentation on the project was given at the 2012 CETL-MSOR Conference. A journal paper is in preparation. Studies which are found during the project are linked to from the **mathcentre** website and thus form an up-to-date archive of research into the effectiveness of mathematics and statistics support.

### 2.6.3 Survey of mathematics and statistics support provision

Mathematics and statistics support centres are now to be found in very many UK universities. Periodically, surveys have been undertaken to gauge the extent of provision, the variation in provision throughout the sector, and the nature of the support provided (when, where, to which student groups &c.).

Extensive surveys have been undertaken by Lawson et al. (2001) and later by Perkin and Croft (2004). Since that time there is anecdotal evidence that many universities which previously reported having no dedicated mathematics and statistics support provision now have this. It is quite possible that some universities which did provide it, no longer continue to do so.

This project gathered, analysed and reported up-to-date information on the current extent of provision. This is important because it assists policymakers in universities to assess whether they are providing student support which is comparable to others in the sector. It will assist practitioners because it will enable them to identify where good practice is being nurtured. It will provide vital information for the **sigma** network on the prevalence of support activity.

The project resulted in

- a project report (Perkin et al. 2012) summarising the current extent of mathematics and statistics support provision;
- up-to-date summaries and links placed on **sigma** network and **mathcentre** websites;
- information on these websites to provide details of where centres are located, who they serve, key contacts, &c;
- a journal article in preparation.

### 2.6.4 Tutoring in a mathematics support centre

This is a guide written for postgraduate students who are working in, or who want to work in, mathematics and statistics support centres. It distills the wisdom of seven people, who have many years experience in mathematics education and in the work of support centres, into a practical resource for postgraduate students. In addition, it contains activities which can be used during training sessions to simulate working in a mathematics support centre (see Section 2.5.1).

### 2.6.5 Gathering student feedback

This is a guide for those running mathematics support centres examining different approaches to gathering student feedback on mathematics and statistics support provision. It formalises the outcomes of the workshop described in Section 2.5.2.

### 2.6.6 Setting up a Mathematics and Statistics Support Centre

The Midlands and East Anglia Spoke of the National HE STEM Programme, as part of the Programme's Practice Transfer Partnership scheme, undertook a project on Retention. This produced a series of eight guides focusing on specific aspects of retention of STEM undergraduates. **sigma** was asked to produce a booklet about mathematics support. The booklet *Setting up a Mathematics Support Centre* (Lawson 2012) presents a series of five case studies (including the Centre at Coventry and three of the first round new funded centres, see 4.2). In addition to describing the nature of the support offered at the five HEIs, each case study presents a "tips and challenges" section outlining difficulties encountered and how they were overcome.

## 2.6.7 How to set up a mathematics and statistics support provision

This booklet (Mac an Bhaird and Lawson 2011) is intended to provide a step-by-step guide for anyone interested in setting up or enhancing a mathematics and/or statistics support provision. The material is presented in short, stand-alone sections which follow the sequence in which someone at an institution with no such support might proceed in order to establish a mathematics and statistics support centre. The material presented in the first seven sections should be sufficient to enable someone to establish a functioning and useful mathematics and statistics support centre that will benefit students in an HEI. The remaining three sections cover ways in which this provision might be further enhanced.

## 2.7 statstutor

Students from an increasingly wide range of disciplines include a statistical element in their project work. Here, statistics is taken as the collection, analysis, interpretation and dissemination of data. For many it is their only encounter with statistics, an encounter that does not always go smoothly.

Statistics is sometimes seen as a sub-discipline of mathematics. However, it does not follow that those capable of teaching or understanding mathematics are necessarily those capable of teaching or understanding statistics, and vice versa, nor that the type of resource which is useful in mathematics support will necessarily be useful in statistics support. For further comments on this important finding, see Section 6.4.

The **statstutor** team are a group of people who work in university mathematics support centres, who teach statistics, and who design new media products for learning.

**statstutor** was developed by staff from Loughborough and Coventry Universities and also the **sigma** network with contributions from the Royal Statistical Society's Centre for Statistical Education<sup>4</sup> and colleagues from other HEIs in the UK. This was part of a pilot project to investigate the potential for the production of different types of learning materials that could be used free of charge by students, lecturers and others looking for post-16 statistics help. The plan was to develop an on-line statistics resource to complement the very popular **mathcentre** site<sup>5</sup> with the aim of providing a similarly wide range of support materials for statistics. The **statstutor** site<sup>6</sup> has a similar structure so that users familiar with the **mathcentre** site should be able to navigate around the **statstutor** site quite easily.

There is a variety of different resources — case study videos, video tutorials, teach yourself materials, tests and quizzes and electronic versions of the very popular *Facts and Formulæ* leaflets. Resources are available on-line, and many may be printed or downloaded. The number of resources available at the moment is limited, but the project hope this will grow in time and would welcome contributions from colleagues in the statistics teaching and learning community.

### 2.7.1 Discipline specific datasets for demonstrating statistical description and tests

The aim of this project was to add to statistics teaching resources in order to address the demand for statistically able graduates in the HE sector and workplace as recommended by Advisory Committee on Mathematics Education (2011). This is a national demand and affects science and social sciences disciplines and contributions were received from Leeds, Loughborough, Sheffield, and York Universities.

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<sup>4</sup><http://www.rsscse.org.uk/>

<sup>5</sup>[www.mathcentre.ac.uk](http://www.mathcentre.ac.uk)

<sup>6</sup><http://www.statstutor.ac.uk/about/>

The project brought together a small collection of datasets suitable for giving examples of statistical description and analysis. Statistics support often requires very specific help, as often it is based around a student's particular project, and demonstrating or giving examples becomes difficult without appropriate datasets. Using the student's own datasets to teach carries the risk of carrying out much of the project work for the student. This collection of datasets and examples allows tutors to teach and explain statistical techniques without having to use the students own data and avoid the above mentioned risk.

This project capitalised on the experience and resourcefulness of statistics tutors within the partner HEIs. The initial collection of datasets was launched at the 2012 CETL MSOR Conference. The developing collection of the datasets and complementary examples will be made available to the mathematics and statistics support community through a database of relevant resources within suitable network website(s) such as **statstutor**.

## 2.8 Distance mathematics and statistics support

Statistics Advisory Services (SASs) have recently been established at several UK HEIs (Patel et al. 2010), offering statistics help and advice to students undertaking a final year undergraduate or masters project or engaged in postgraduate research. A SAS is appointments based and is normally provided in addition to drop-in support offered via a mathematics support centre. Typically it offers statistics advice in relation to aspects of study design, questionnaire design, data analysis, use of statistics software, and the interpretation and reporting of results. However, not all UK HE institutions currently offer this type of SAS, possibly due to a lack of suitably experienced personnel or financial resources. Two projects explored the possibility of delivering statistics support at a distance.

The objectives of the first project<sup>7</sup> were to identify the practical and pedagogical issues associated with sharing an on-line SAS resource between several HEIs, and to elicit the opinions of students using the service in order to understand their expectations and experience of using this type of on-line support. Students opinions were sought via a follow up on-line questionnaire; more in depth opinions were gathered from three students via follow up case study interviews, summarised by Owen et al. (2012).

The project facilitated a total of 68 appointments taken up by 46 students from the three partner institutions. These partner institutions were Birmingham City University, De Montfort University and the University of Sunderland. A statistics advisor was employed as part of the project, working remotely from her home. The students met with the statistics advisor using the Elluminate<sup>8</sup> on-line learning space/web meeting tool. The Elluminate learning space was provided by Loughborough University which has recently adopted Elluminate as its primary on-line learning space. For the last two years this tool has been used to provide on-line access to the SAS for Loughborough University students who are studying or researching part-time or via distance learning.

The over-riding picture that emerged from the study was that the students found Elluminate easy to use and both the students and the statistics advisor felt that this tool has many advantages for use in the provision of this type of on-line support. In terms of the pedagogical value of the service to the students, 85% of the students completing the survey reported that they were able to obtain help with 'Most' or 'All' of their statistics problems and the remaining 15% reported

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<sup>7</sup>Funded as part of the National HE STEM Programme by the Maths Stats and OR Network's Mathematical Sciences Curriculum Innovation Project and managed by **sigma**.

<sup>8</sup>Now known as Blackboard Collaborate (see [www.illuminate.com](http://www.illuminate.com))

that they were able to obtain help with ‘Some’ of their statistics problems. Furthermore, all but one student in the survey considered their overall experience of the service to be ‘Good’ or ‘Very Good’ and these same students said that they would use this service in the future if there was no alternative source of support and would also recommend this service to a friend.

This pilot study has therefore demonstrated that an on-line SAS is able to offer a practical alternative to an institution specific face-to-face SAS if suitably experienced staff are not available locally. In addition, it has shown that it is feasible for this type of service to be shared by a number of institutions and that this might offer a viable option in order to share the financial costs of providing such a service.

The second project investigated the feasibility of providing mathematics and statistics support to learners in the workforce. Staff at the University of Northampton were aware that part-time students had difficulty accessing drop-in provision because of their work commitments or the travelling required to attend the centre. Initially evening drop-in sessions were offered, but these did not prove attractive to the students. They therefore investigated the provision of live online support for these students. Elluminate was used as a vehicle for providing this support and a pilot group of part-time Engineering students was targeted. The project did not prove successful in engaging these students and only a handful of support sessions were delivered.

## 2.9 Communication

A fundamental aim of the National HE STEM Programme funding was

Establish the **sigma** Mathematics Support Network, a free association of staff and institutions providing mathematics support who work together to share resources and experience

Because, by definition, this would be a dispersed and decentralised network, steps to provide a communications infrastructure to underpin its activities were set out in the original **sigma** network proposal. These steps, specifically communication and dissemination mechanisms via the web and e-newsletter &c., were implemented as described in this section.

In the event, these mechanisms played a relatively small part in the success of the overall **sigma** network. The regional hubs were very active in setting up local events on topics of mutual interest so people engaged in mathematics and statistics support had many opportunities to meet face to face to share experiences and insights. The CETL-MSOR conferences have continued to attract many from this community, providing another important vehicle for such interactions. Finally, as new activities have got under way — the newly-funded centres for example — the **sigma** Central Hub has paid particular attention to reporting and mentoring, thereby providing further communication opportunities and mechanisms. Each of these has significantly reduced the need for other ways of maintaining contact.

However, the mathematics and statistics support community is very anxious to ensure that the end of National HE STEM Programme funding should not be the end of a vibrant **sigma** network. In this new situation, face-to-face contact is likely to become much less frequent and the formal requirement for reporting and mentoring will cease. Electronic communication will become more important so this chapter also looks forward to ways in which the new needs can be met.

## 2.9.1 Website

A website<sup>9</sup> was developed and launched in 2010. It has been on line throughout the project giving the **sigma** hubs a mechanism to advertise their activities to the mathematics and statistics support community and also to advertise the project's presence to the wider world. The South West and South Wales hub also has a website<sup>10</sup> serving its particular needs and those of its partners.

The **sigma** network website has been used much less than was anticipated. In retrospect it was over-designed and hence difficult for administrative users who were IT-literate but did not have coding skills to keep up to date. The design also made assumptions about the way the **sigma** regional hubs would relate to each other and to the wider **sigma** network which proved to be unfounded. For example, a blog facility provided for each of the **sigma** regional hubs was hardly used.

There was also in users' minds some confusion between this site and a similar site<sup>11</sup> developed previously as a legacy of the **sigma** Centre for Excellence in Teaching and Learning<sup>12</sup>. Some resources were duplicated between the two sites and other resources which a visitor might reasonably expect to find, such as guidance on evaluation of mathematics and statistics support centres, was hard to find or absent altogether. Finally, there seems to be some uncertainty about what could and should be offered to student visitors to the site.

Learning from this experience, a much simpler website<sup>13</sup> has been designed and developed. This will replace the two existing websites once it is fully populated with the information being collected in the final few weeks of National HE STEM Programme funding. As speedy and effective communication will be vital to the continuing network when it begins to be run by volunteers, it is crucial that the new website makes this as easy as possible. Student and other visitors seeking learning and teaching materials will be directed to **mathcentre**<sup>14</sup> where a wealth of these can be found.

## 2.9.2 e-Newsletter

Eight newsletters<sup>15</sup> have been published during the period of National HE STEM Programme funding. Much of their content has been information about forthcoming events within National HE STEM Programme overall, provided by **sigma** or likely to be of interest to those working in mathematics and statistics support. Similarly interesting to this audience are profiles of winners of the **sigma** Prize (see Section 2.3).

## 2.9.3 Supporting a maturing community of practice

An important outcome of the **sigma** network has been the continued maturing of the community of practice in mathematics and statistics support, first documented by Samuels and Patel (2010). They provide evidence of maturity and scholarly practice within the UK Higher Education mathematics and statistics support community of practice. Great strides towards fully evidence-based practice in mathematics and statistics support have been taken during the last three years. The

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<sup>9</sup><http://sigma-network.ac.uk>

<sup>10</sup><http://www.bath.ac.uk/study/sigma-sw/index.html>

<sup>11</sup><http://sigma-cetl.ac.uk>

<sup>12</sup>[www.hefce.ac.uk/cetl/](http://www.hefce.ac.uk/cetl/)

<sup>13</sup>Temporary url: <http://vip.apluk.org/>

<sup>14</sup>[www.mathcentre.ac.uk](http://www.mathcentre.ac.uk)

<sup>15</sup><http://sigma-network.ac.uk/resources/sigma-newsletters>

extensive literature review to find published work concerning the effectiveness and impact of mathematics and statistics support (see Section 2.6.2) and the publication of the guide to gathering student feedback on mathematics and statistics support provision (see Section 2.6.5) are tangible indicators of this maturing. Equally important is the web of personal and professional contacts which enables experienced practitioners to continue their personal development and also provides newcomers with guidance and support. It is crucial to the sustainability of the work carried out in the **sigma** network that the communications infrastructure fosters these human processes.

## Section 3

# Creating a community of practice: the role of the sigma regional hubs

This chapter describes the **sigma** regional hubs and their activities in contributing to the creation of a community of practice in mathematics and statistics support. During the period of CETL funding, **sigma** had established two hubs: one in the South-West and South Wales, based at the University of Bath and one in Scotland based originally at St Andrews University but, due to the maternity leave of the hub coordinator, relocated to Glasgow University. Both hubs had been successful in drawing together their local constituency and running well-attended local events. Therefore, one of the aims of the National HE STEM Programme funding was to create a network of those involved in maths support based on six regional hubs building on the model piloted by **sigma** CETL.

### 3.1 Aim and objectives

The aims for each of the regional hubs were:

- identify its local constituency;
- promote and host at least 2 local events per year;
- gather, analyse and report evaluation data;
- provide updates for the Network website;
- report in the e-newsletter;
- contribute to the annual conference.

### 3.2 Outcomes

Prior to the funding submission to the IMA and the award of the National HE STEM Programme contract, **sigma** had secured commitments from staff at the following institutions to co-ordinate regional hubs:

- South-West and South Wales — this would continue to be based at the University of Bath

- North-East — University of Leeds (later joined by the University of Sheffield)
- East Anglia – Suffolk New College (now University Campus Suffolk)
- South-East – Brunel University

Loughborough and Coventry Universities together acted as the central hub and regional hub for the Midlands. It was anticipated that a coordinator would easily be found for a North-West and North Wales hub; it was agreed later that this hub would be based at the University of Liverpool.

### 3.2.1 The local constituencies

The **sigma** North East and Yorkshire hub has 24 active members representing 14 different HEIs and events have been attended by participants from the universities of Birmingham, Huddersfield, York, Sunderland, Hull, Shefeld Hallam, Lincoln, Bradford, Leeds Metropolitan and Newcastle.

The **sigma** South West and South Wales hub has contact with at least one representative from 17 institutions in the region. The core institutions are Bath, Cardiff, Exeter, Glamorgan, Gloucestershire, Portsmouth, Plymouth, and Bristol Universities and the University of the West of England.

The **sigma** Eastern England hub is based in University Campus Suffolk, maintaining active links with 10 of the 13 universities in the area, namely Anglia Ruskin, Bedfordshire, Cambridge, East Anglia, East London, Essex, Hertfordshire and Lincoln Universities together with University Campus Suffolk and The Open University.

The **sigma** North West and North Wales hub, based at the University of Liverpool, has 32 members drawn from Liverpool, Liverpool John Moores, Bolton, Chester, Edge Hill, Manchester, Manchester Metropolitan, Bangor, Glyndwr, Salford and Cumbria Universities and the University of Central Lancashire.

Engagement with the **sigma** South East hub has been mainly from London universities: Brunel, Kingston, Imperial, City, Queen Mary, Westminster, South Bank, Hertfordshire, and Middlesex.

The national responsibilities (see Section 2) of the **sigma** Midlands Hub has brought it into contact with all the HEIs in its region, namely Aston, Birmingham City, Birmingham, Coventry, Derby, Keele, Leicester, Loughborough, Northampton, Nottingham, Nottingham Trent, Staffordshire, Warwick and Wolverhampton Universities.

### 3.2.2 Activities

Having identified their local constituency the **sigma** regional hubs were given an explicit remit to promote and host at least two local events in each academic year, which they have done with enthusiasm. The extent of the outreach of these events to all parts of the HE sector can be found in Appendix A.

An overall benefit of regional hub activities is an awareness that within each region there are practitioners with a range of experience and the willingness to share this. This is ensuring increased professionalisation of mathematics and statistics support, something that a strong professional network such as **sigma** can promote and encourage.

### 3.2.3 Events and highlights

Regional hub events have covered the whole range of mathematics and statistics support responsibilities; these are a few highlights from a very varied programme:

- Several regional hubs have held events focusing on statistics support, an increasing part of support centres' activities. Issues covered include the support for the more ambitious students, the availability of support resources such as **statstutor** and ways to find and use realistic data; a **sigma**-funded project involving Leeds, Sheffield, Warwick and York Universities has grown out of the need for data with known pedagogic value (see Section 2.7.1). Much discussion has endeavoured to identify the differences in support needs for statistics as compared with mathematics;
- The South West and South Wales hub had a summer internship programme which sponsored students from constituent universities to carry out small but significant research projects relating to mathematics and statistics support. Student presentations of their work at CETL-MSOR 2011 were very well received;
- The availability of support resources in mathematics and statistics has been discussed at several regional hub events, including some on the open educational resources collected during the FETLAR project<sup>1</sup> and those developed in the MathEG project<sup>2</sup>. The increasing variety and sophistication of on-line resources — Geogebra<sup>3</sup> for example — makes this a topic of enduring interest;
- There is great variety of modes of operation of mathematics and statistics support services across the sector. Several regional hub meetings have discussed the strengths and weaknesses of different ways of delivering the necessary support although, as might be expected, no one of them was found to meet all the needs;
- An important question which exercises almost everyone involved is how to reach those students who could benefit from but do not make use of mathematics and statistics support services. Several meetings have discussed this and heard of innovative schemes such as training student to act as ambassadors for the support service among their fellow students.

It was natural that the **sigma** regional hubs should make the important commitment that the programme for a local event could be readily transferred to another regional hub. It could then be re-presented to another regional audience without the need to recreate the programme from scratch. For example, on 16 March 2012 the Eastern England hub hosted a very well received **sigma** network event entitled *Mathematics Support for Nursing and Midwifery Students* which prompted the North West and North Wales hub to host a similar event on 15 June, 2012. In the same way, the internship programme developed at South West and South Wales hub was adopted subsequently by the Midlands hub.

### 3.3 The Midland Regional Dyscalculia Centre

The Midland Regional Dyscalculia Centre was set up at Loughborough University, within the Eureka Centre for Mathematical Confidence. This initiative, funded by the National HE STEM Programme through the **sigma** network, is an important part of the support provided by the **sigma** Midlands regional hub to HEIs in its constituency giving students access to specialist support that was not available in their own institutions. The Centre's team of experienced tutors aim to help

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<sup>1</sup><http://www.fetlar.bham.ac.uk/>

<sup>2</sup><http://www.mathcentre.ac.uk:8081/mathseg/>

<sup>3</sup><http://www.geogebra.org/cms/>

dyscalculic and dyslexic students overcome their barriers in numeracy, mathematics and statistics-based courses by providing support with a range of study skills in mathematics, including

- the understanding of number and numerical operations;
- relationships between numbers;
- graphical and algebraic skills;
- strategies to aid memory for mathematical facts;
- reading support for mathematics tasks that embed notation within text;
- writing mathematical and statistical solutions and reports;
- exploring revision techniques.

The objectives are to enable the student to increase their mathematical confidence, reduce the associated anxiety and achieve academic success, becoming independent in their learning.

### **3.4 Contributing to sustainability**

Regional hubs are exploring how they will ensure sustainability beyond 31 July 2012. Whereas continuing support from the home institution was a requirement for receiving National HE STEM Programme funding to establish a support centre, there was no such requirement for regional hubs. A meeting of **sigma** regional hub coordinators and other interested persons was held at Loughborough University on 4 May 2012 to plan the future of the **sigma** network beyond the end of the National HE STEM Programme funding. The programme of regional meetings was highlighted by both regional hubs and funded centres as very valuable in continuing the development of a community of practice. This prompted a unanimous commitment from the regional hub coordinators to maintain this programme beyond the end of National HE STEM Programme funding. These views were expressed with no expectation of additional funding and demonstrate the sustainability of the regional hub model

## Section 4

# Expanding the community of practice: new funded centres

This section describes the process through which the new **sigma**-funded mathematics and statistics support centres were established and their progress.

### 4.1 CETL centres

As part of its CETL submission, **sigma** committed to provide funding and support to enable the University of Leeds to set up a mathematics support centre. This was accomplished in 2005. In 2007, after a competitive funding call (requiring matched funding), **sigma** gave pump-priming funding to the Universities of Bath and Sheffield to establish mathematics and statistics support provision. Initial funding was for a period of two years. Each of these initiatives has become embedded into the Universities respective Teaching and Learning strategies and continues to be internally funded. In its OFFA Access Agreement Sheffield University explicitly identifies the contribution to widening access and improving retention which its Mathematics and Statistics Help<sup>1</sup> (MASH) centre makes and a student commented “thanks for all the help, don’t think I’d have stood a chance without you lot!”. See Section 6 for evaluations of other **sigma**-funded centres, at the level of inclusion in OFFA agreements, student feedback and in many other ways.

### 4.2 National HE STEM Programme first round centres

The National HE STEM Programme saw that the experience of the **sigma** CETL in stimulating the development and adoption of student support showed the way to a much wider adoption of mathematics and statistics support. **sigma** arranged a two-stage competitive funding call in 2010. Stage 1 saw the submission of 16 proposals, nine of which were progressed to Stage 2. After due consideration, the following four stage 2 proposals were approved for funding: University of York, London Metropolitan University, Lincoln University and University of Central Lancashire. Each centre received £15,000 over two years, with match funding in addition from their host institution. In addition, a further £6,000 was awarded to the University of Kent to improve their provision – the monies came from the National HE STEM Programme Hub but was managed by **sigma**. Letters of Agreement were issued and each centre required to submit regular progress reports during the two year funded period.

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<sup>1</sup><http://www.sheffield.ac.uk/mash>

In order to identify the extent of support for continuation beyond July 2012 of the first round of funded centres a letter was sent to a senior member of staff at each institution in May 2011. The responses were uniformly appreciative of **sigma** funding and of what had been achieved by mathematics and statistics support staff during the first year of operation.

#### 4.2.1 Implementation

The different institutional environments and their plans for continuing provision in the future have resulted in slightly different approaches being adopted. The centre at the University of Kent is staffed by postgraduate students, York has established a drop in service and at London Metropolitan the emphasis is on one-to-one appointments. At Lincoln, the Mathematics & Statistics Support Centre, which was established in the University Library, made statistics support its major focus. Although restructuring of the University resulted in major changes of personnel in July 2011, the Centre continues to have strong support from senior management.

At the time the **sigma** funds were awarded, the University of Central Lancashire had no centralised or formalised support for mathematics and statistics so the aim was to address that deficiency. In the event, uncertainty created by ongoing large-scale reorganisation at the University delayed implementation of the plan to work with both the student study skills support unit and the employability support unit to extend considerably the mathematics and statistics support available to students. Following formal visits by the Assistant Director of **sigma** in late 2011 and early 2012, mentoring by an experienced member of the mathematics and statistics support community was put in place in the expectation that this would retrieve an unsatisfactory situation.

### 4.3 Reports from first-round centres

All new centres are required to submit evaluations. Highlights of the reports<sup>2</sup> for the academic years 2010–11 and 2011–12 from centres set up in the first round of funding are summarised below. Both Kent and Lincoln reported that further tutors had to be recruited to cope with student demand.

#### 4.3.1 University of Kent

Staff from the Student Learning Advisory Service reported that in its first year of operation, the **sigma**/University of Kent joint-funded mathematics and statistics clinics have proved highly successful, the take-up rate has been excellent and the one-to-one appointments are clearly valued by students.

The Director of the Unit for the Enhancement of Learning and Teaching reported that she had “gained very positive feedback from students. As a result of the hard work and dedication of all those involved, these clinics are developing into an integral and vital part of student learning support at the University of Kent, and we are extremely grateful to **sigma** for providing the funding which has allowed us to establish the scheme”. Feedback from 75 respondents has been overwhelmingly positive: 92% agreed/strongly agreed that the clinics provided an opportunity to discuss their concerns, while 94% agreed/strongly agreed that they found the advice useful and practical.

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<sup>2</sup>For the most part these are close-to-verbatim extracts from reports provided by project leaders so the active voice and first person are retained to preserve the immediacy and tone of the reports. The author reiterates his earlier acknowledgement in 1.6 of the value of these reports in preparing this document.

In the second year of operation, mathematics and statistics clinics continued to be timetabled for a total of 8 hours per week - 4 hours maths and 4 hours stats respectively - throughout the Autumn and Spring terms, and for the first three weeks of the Summer term. Six postgraduate students were recruited and appointed in September 2011 to serve as tutors /mentors. This allowed us to reduce the teaching load to a sustainable level for all concerned. A review meeting took place on 1 May 2011, between the mathematics and statistics mentors, the manager of SLAS, the mathematics and statistics coordinator, as well as with the administrator in SLAS. It was agreed that the mathematics and statistics clinics have been successful. Mentors were commended for their hard work, commitment and dedication to making a success of the clinics. Their professionalism and willingness to help and impart of their experience and expertise to other students seeking help and support with either mathematics or statistics were praised. In order to improve the service, the clinics were run according to the patterns described below:

- The clinics were advertised extensively, via the University's staff and student portals, by a poster campaign and through leaflets. This advertising was continued throughout the year to develop general awareness of the clinics and encourage good participation rates;
- As space is problematic and as Wednesday afternoon is a non-teaching afternoon, this slot seems to be the ideal/most popular time for the maths/stats clinics; so both the mathematics and statistics clinics were set up on Wednesday afternoon, in a building at close proximity to the SLAS Offices.
- Each mentor staffed the clinics for two consecutive hours for either mathematics or statistics;
- Students arranged an appointment at the clinic by contacting SLAS main reception by email, phone, or in person;
- Details of students having booked appointments were sent to mentors on Monday morning. These details included specific course module and any other pertinent information.

In contrast to last year, demand was noticeably higher in the spring term than in the autumn. Overall numbers are slightly lower, but not substantially so (142 versus 164). This might reflect the loss of previous pent-up demand, and also incentives to further develop mathematics and statistics tuition within Schools. The quantity of appointments will continue to be monitored closely in terms of balancing costs against capacity.

Feedback from 43 respondents in 2011-12 has again been overwhelmingly positive: 95% agreed/strongly agreed that the clinics provided an opportunity to discuss their concerns, and 95% agreed/strongly agreed that they found the advice useful and practical. Individual student comments included "The advice was incredibly useful", "I think [the service] is perfectly fine", "Everything was sorted very quickly!", "All my concerns were answered" and "I have taken on board the advice given and it has been really useful to me. I would also like to book some more appointments in the future".

### **4.3.2 University of Central Lancashire**

Delivering support in the academic year 2010–11 was much less straight forward than planned or hoped, as the University was concentrated on preparing for students starting in autumn 2012. This has led to restructurings, resignations, retirements and new initiatives. MathsAid has been affected by these developments in two ways: uncertainties over responsibilities in newly reorganised services have led to various challenges including advertising and accessing financial accounts; uncertainties

over next year's income and the content of 'UCLan Advantage', the University's major recruiting offer to new students, have delayed decisions over resources.

Notwithstanding, realistic arrangements with schools, course leaders and particular module leaders were made for the 2011–12 academic year and a lecturer with wide experience of teaching statistics joined the MathsAid team. Most student enquiries were about numeracy and materials that might be expected to be studied at GCSE level, such as rearranging equations, substituting values, finding roots and powers, calculation of percentages and areas.

Major efforts have been made to ensure UCLan continues the service after **sigma** funding finishes, as the University moved towards identifying what students will expect in 2012 for their £9000 fees. This should be positive for MathsAid and all concerned are optimistic that everything will be in place in September 2012 to expand the visibility and provision of the service for next year.

### 4.3.3 University of Lincoln

Records for the academic year 2010–11 show that 225 visits for support were made by 177 different people. Undergraduate level 3 dominates with half of all visitors, 17% of the visits were postgraduates and 16% were 1st-year undergraduates. The duration of visits was highly variable (mean 49 minutes, standard deviation 30 minutes) reflecting the depth that some statistical support work has to go into and highlighting the difficulty of planning ahead. Usage occurred across 11 Schools with Psychology, Natural & Applied Sciences and Sports, Coaching & Exercise Science generating over 75% of visits. These are all in the Faculty of Health, Life and Social Sciences, from where the initiative to set up the centre had come. Most of the remaining visits were from the Business School.

The Vice Chancellor, Professor Mary Stuart reported that "I'm very pleased to say that the centre has already proved its worth in the first year" and 15 out of 17 students surveyed as part of the centre's self-evaluation stated that the support and guidance they received noticeably helped their work.

In the academic year 2011–12 the Mathematics and Statistics Support Centre became part of the University's Learning Development function and rebranded to match its style. Posters and flyers were produced; the flyers were made into double sided sheets, with mathematics and statistics information on one side, Learning Development information and guidance on the other. This was to move towards a more centralised presence and comprehensive support unit. The web presence of the Centre has been increased. The blog has been updated and is being maintained on a regular basis. A Twitter account has been made, with an embedded widget on the blog. Twitter is being used to update students about the opening hours, for links to interesting resources and comments about the centre. This is now being followed by 48 people.

Also in the academic year 2011–12 the Mathematics and Statistics Support Centre has been involved in the development of a new website to provide access to mathematics and statistics resources and diagnostic tests. This is a project led by a lecturer in the University's Engineering School, and is a **sigma**-funded project. This website will allow tutors to create mathematical and statistical tests from pre-made question sets to roll out to their students. The main objective of this website is to test the students to identify their individual weaker areas, giving them suggested resources and advice for improvement. Initially first year engineering students will be targeted, with the aim to roll it out to the whole university.

#### 4.3.4 London Metropolitan University

To begin with the Mathematics and Statistics Support Clinic was set up within the mathematics subject area within the Faculty of Computing as a free drop-in service for any student within the Faculty. It proved to be a valuable resource from the outset, providing assistance to 218 visitors over 24 weeks of operation in the academic year 2010–11. Of these, 131 students were in their first year, 47 were in their second year and 36 were in their preliminary year before beginning the first year of a degree. Preliminary year students most often asked for help with foundation mathematics, first year students with calculus, logic and statistics and second year students most often asked for help with statistics and differential equations.

In the academic year 2011–12 the clinic was held in an open space on the mezzanine floor of the University library, a very busy area designated at other times for individual or group self-study. It was advertised as a resource for one-to-one help on the Weblearn page of each first year maths degree module. A request was made for first year module leaders of other degrees within the faculty to offer the information on their pages. In addition a page of information was created on the Faculty of Computing web pages. Details were also listed of the web-page of the University's Centre for the Enhancement of Learning and Teaching which had agreed to accommodate the clinic within their space in the library. The number of students helped by the clinic increased to 268 in the academic year 2011–12, helped by this more prominent location.

"Students are very happy and grateful to [centre staff]" according to Professor D. Palmer-Brown, Dean of Computing. Among students' comments were "You helped me to pass this module; without you I wouldn't have done it" and "I really appreciate what you did; I understand what I wrote now".

#### 4.3.5 University of York

The Maths [sic] Support Project has been highly visible within the institution and very successful in reaching and supporting students. Particularly noteworthy is the report of the 2012 QAA Institutional Audit which states that the review team found "the successful establishment of the Maths Skills Centre to support students across a wide range of disciplines" to be a feature of good practice.

The project was set up to provide University-wide support for mathematics learning, independent of departments, but in conjunction with what departments already provided. Initially, the main provision has been the creation of the drop-in Maths Skills Centre.

Professor Trevor Sheldon, Deputy Vice-Chancellor, has written that "I consider the first year of the Maths Skills Centre to have been a great success, and I thank **sigma** for the advice and input provided to our Project Officer throughout the year". A student commented that "I like the friendly atmosphere and the way staff don't lose patience with students despite our daft and repetitive questions. They don't tell us the answer but enable us to do it for ourselves, making the students feel good about themselves".

Findings from student usage data for the Maths Skills Centre in the academic year 2010–11 and student feedback include the following:

- There have been 143 unique visitors and 591 total visits (an average of 4.8 students in each two-hour session). 89 students visited the Centre more than once, with 41 students visiting five or more times;
- The Centre continues to attract new students. In the final five weeks of term two, the Centre attracted an average of 1.2 new students per day;

- 80% of students report feeling more confident in mathematics as a result of the Centre, 95% believe the Centre has helped their attainment, and out of six students who reported considering leaving their degree because of mathematical difficulty, three believe the Centre helped them stay at university;
- Students value the staffed drop-in service above and beyond other forms of support (both departmental- and Centre-based). In part this is because it allows them to manage their study time more effectively.

For the second year of operation — the academic year 2011–12 — the Centre has been advertised to students across all subjects, and has been open to students from all year groups. Information about the Centre was included in every first years fresher welcome pack. This is a change from last year’s decision to only advertise to students whose modules include, or require, elements of algebra and calculus, and attracted students from a wider variety of subjects. In this academic year there were 167 unique visitors and 407 total visits

In another new departure, two postgraduate tutors funded by the Economics department offer specialist drop-in support for second and third-year Economics students as these had been frequent users of the Centre in the previous academic year. This model for expansion of specialist later-years support that is reliant on departmental funding is something the Centre will evaluate and possibly expand in the future.

The maths drop-in service continues to be found more useful than any other form of support available: 90% of students find the Centre’s tutors ‘always’ or ‘often’ helpful, with the remaining 10% finding them ‘sometimes’ helpful. Student comments include “the tutors were really keen to help and really went the extra mile to ensure I understood”, and “Having someone who is willing to give the time to go through areas of maths or maths questions in more detail than lectures. And much less intimidating than going to see the lecturer!

### **Postgraduate statistics workshops**

In October 2011, the Yorks Graduate Student Association contacted the Centre asking if there was any provision for introductory statistics support for taught and research postgraduate students. At that stage, there was only generic drop-in support, and it was considered that a series of workshops was the best form of delivery for this type of support. Following consultation with departments the foundation statistics course comprising three one-hour workshops was developed and delivered in the 2012 Spring term. The first workshop looked at descriptive statistics, data types, measures of central tendency, measures of dispersion, and the Normal distribution. The second workshop looked at using graphs to display data, drawing these in computer packages, good style, and requirements for publishing graphs in journals. The third workshop introduced hypothesis testing, and looked at the role of  $\alpha$ ,  $\beta$ , power, effect size and sample size in the context of an independent t-test. Each workshop combines a PowerPoint presentation with computer- based tasks (on Excel and SPSS), and was presented three times over the Spring term.

## **4.4 Mathematics and statistics support in Wales**

. **sigma** has had a significant impact on the provision of mathematics and statistics support in Wales through a number of channels, the **sigma** Network, the new centre funding initiative, the PTA scheme and through collaboration with the Wales National HE STEM Programme Spoke.

The **sigma** Network, which was set up in 2010, has two regions which jointly incorporate Wales. The **sigma** South West and South Wales hub has Cardiff University and the University of Glamorgan as core institutes, and the **sigma** North West and North Wales hub has participants from Bangor and Glyndŵr universities.

In 2010 the Wales Spoke of National HE STEM Programme decided that it wanted to establish new mathematics and statistics support initiatives across institutions in Wales. They quickly realised that **sigma** were the leading experts in this area and requested advice on best practice. The Assistant Director of **sigma** was invited for discussions and she advised representatives of the Welsh Spoke on the various models of mathematics and statistics support that were in use, as well as advice on the use of resources such as HELM<sup>3</sup>.

The Wales Spoke of the National HE STEM Programme decided to employ the model of using postgraduate students to provide drop-in support. Swansea University was used to pilot the scheme and **sigma** provided a training session for tutors organised in Cardiff University. The pilot scheme was successful, and as a result a competitive funding call was announced for the 2011–12 academic year.

The eight successful bids were from Aberystwyth University, Bangor University, Glyndŵr University, Swansea Metropolitan University, Swansea University College of Engineering, Swansea University College of Science, University of Glamorgan, and the University of Wales, Newport. Prior to the commencement of these initiatives, **sigma** provided three further training workshops for all participants.

The scheme has been successful in its first year, and although the engagement levels are low, the feedback is very positive and there is a general commitment from the institutions to continue to provide this support after the end of the National HE STEM Programme funding. Representatives from **sigma** were invited to attend two review meetings in March and June 2012. During these reviews, representatives from each institution presented on their support, and **sigma** advised on the various issues that they raised.

Alison Braddock, Regional Director of the Wales Spoke of the National HE STEM Programme has written “**sigma** has been hugely supportive of the Wales Spoke of the National HE STEM Programme which helped to run a pilot maths support centre in the College of Engineering, Swansea University, and then assisted academic colleagues in setting up eight new maths support centres in seven universities in Wales”.

The 2011–12 Practice Transfer Adopters call which aims to enhance the existing mathematics and statistics support provision awarded funding to Cardiff University to set up students as ambassadors for mathematics and statistics support. Cardiff Metropolitan University received funding from the 2012 competitive funding call for the establishment of new centres.

## 4.5 National HE STEM Programme second round centres

Having identified mathematics support as one of the successes of the National HE STEM Programme, the Executive Committee made additional funding available to **sigma** in early 2012 for the creation of six new centres. Immediately after release to **sigma** of further funds from the National HE STEM Programme the second competitive funding call was announced. Because of the extremely short time scale there was a one-stage application process in this round; otherwise the selection process was similar to the first. In the light of the large number of high quality proposals that were received during the bidding process, the funding was increased to enable nine

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<sup>3</sup>Helping Engineers Learn Mathematics; <http://helm.lboro.ac.uk/>

new centres to be supported, at Anglia Ruskin, Birmingham, Brighton, Cardiff, Keele, Liverpool, Liverpool John Moores, Warwick and Wolverhampton Universities.

#### 4.5.1 Support and mentoring

Shortly after the call for submissions from institutions, potential bidders were invited by the Central Hub to a meeting to provide guidance on the application process and on the indicators against which applications would be evaluated. Shortly after the names of institutions whose bids had been successful had been announced, staff from those institutions were required to attend a launch meeting at which project plans were clarified and refined with advice from experienced practitioners.

Building on experience gained in the first round and in view of the very short timescale, **sigma** also provided mentors. These were experienced members of the wider support community who were available to review the various plans and actions, advise on best practice and could be called on should any issues arise. The reports on second-round centres from mentors are reviewed below (see Section 4.5.2).

In mid-July 2012, shortly before National HE STEM Programme funding ceased, **sigma** facilitated a meeting for representatives of the centres funded in the second round to share experiences and difficulties and report on plans for continuation into the forthcoming academic year.

#### 4.5.2 Evaluation of second-round funded centres

In the following sections are précis of reports from mentors<sup>4</sup>, which in almost all cases exemplify the energy and commitment of those involved in establishing the new centres.

##### Anglia Ruskin University

I feel the project will ultimately achieve its aims moving into phase 2 in the new academic year from September 2012. It has learnt from its experience in phase 1 that new developments within a large institution can move exceedingly slowly. In September 2012 the project intends to be closely involved with university induction for new students, and pro-actively supporting students to deal with transition to HE. The staff are already liaising with staff around the university in order to have an input here. The project has established a sound "infrastructure" in terms of its staffing, emerging promotional profile, a good name ("MathSpace") and promising partnerships with other institutional stakeholders, including the Student Union and Student Services. One outstanding issue is the location of the mathematics and statistics support service going forward, in order to identify a "home" which is more highly visible as an accessible and impartial learning space which can be branded and resourced accordingly.

The project lead is a relatively senior member of staff who has experience of the mathematics and statistics support needs of students, and who can support the project tutors accordingly. He and his close colleagues are active members of the Eastern England **sigma** Hub. We look forward to the Anglia Ruskin University mathematics and statistics support centre MathSpace contributing to, and benefitting from, the activities of the **sigma** network over the coming years. Institutional commitment to this project seems sound. I cannot identify any urgent issues which threaten the immediate future of this project.

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<sup>4</sup>For the most part these are close-to-verbatim extracts from reports provided by mentors so the active voice and first person are retained to preserve the immediacy and tone of the reports. The author reiterates his earlier acknowledgement in 1.6 of the value of these reports in preparing this document.

## **Birmingham**

Work is in hand so that a more developed offering is available for new students in October. The presence of mathematics support forms part of a wider strategic plan to improve support provision. This will ensure sustainability and senior management support. There are no urgent issues that need resolving as far as I have been made aware. I believe that in the medium term the project will achieve its objectives and will have a positive influence on the institution and its students. The project lead is very active within the wider community – for example working with colleagues in Newcastle on a diagnostic testing project, and contributing to UK-wide mathematics and statistics support workshops. I am confident that the Centre will continue to develop as expected. Michael is in contact with other new **sigma**-funded centres in the Midlands and they have plans to share resources, on postgraduate training for example. I remain in regular contact with Birmingham staff, and we have had many conversations about the ways in which he might develop the Centre. I look forward to visiting again in the new academic year to see how things have developed.

## **Brighton**

Timing issues mean that funds will be sufficient to pay for PhD tutors for two academic years which will allow the service to become embedded within university support structures. I am confident that the so-called  $\pi$ -Shop will continue to attract students and thereby will become a useful provision for undergraduates in Brighton. Careful consideration of appropriate tutor training is necessary but the steering group is aware of this and has plans to ensure that tutors will be of a good quality.

The steering committee seems to be a good way to ensure that the the  $\pi$ -Shop will develop. A series of launch events is likely to be a useful way to raise awareness of the service. I am not sure about how diagnostic testing works in a support centre setting but there are other institutions which can probably help with this. Staff in Brighton are attending the CETL-MSOR conference and are increasingly aware of colleagues nationally who may help them with particular issues. I will make sure that I talk with the project lead at the CETL-MSOR Conference in Sheffield to see if there is anyone that I could introduce him to based on his interests.

## **Cardiff Metropolitan University**

Initial discussions focused on the pilot period and some consideration was also given to the longer term possibilities within the institution. For the pilot project, it would seem the goals set out to develop mathematics support mechanisms for Computer Science students are appropriate and achievable. For example, during the pilot it is expected that one or two existing staff members will provide the mathematical support and a suitable location has already been highlighted. It will take a full session (2012–13) to evaluate the provision but it is hoped that some support can be arranged during the current exam period to provide further insight in to what is likely to be required in the next academic session. During this pilot period, it is encouraged that more details are determined about how such support might be expanded to a wider body of students and what resources/funding &c. are likely to be available for this to take place.

## **Keele**

The mathematics support unit, known as *In Addition: Maths Open Learning Service*, is located within the Careers and Employability Centre, Walter Moberly Building which houses a number of other student support services such as dyslexia support. This is seen to be an advantage, in that

there is an anticipated 'passing trade' benefit and university-wide publicity and signage for the services on offer.

My discussion with the project leader focused mainly on plans for the future, particularly the start of the next academic year. I was impressed by the way that a serious publicity drive had already been planned – through dedicated slots in the fresher programme, use of the campus radio, and explicit visits to target departments in the early days of the new session. As I write, I have no concerns about the long-term viability of mathematics and statistics support at Keele. The provision seems to be fully embedded in the general support services available on campus and appears to have the support of the university more generally. I look forward to meeting with the postgraduate tutors from Keele in the future and see this as an example of successful transfer and adoption.

### **University of Liverpool**

The mentor reported that

I do not know if the project has made adequate progress. . . . However, I am afraid that because of what has happened to date, I have reservations about the long term future of the project.

In response, the directors of **sigma** have said;

**sigma** has been disappointed that, to date, the new centre at Liverpool has not developed as planned notwithstanding that the **sigma** mentor had provided on-going advice and encouragement. We have been assured that there is still a commitment from the Centre for Lifelong Learning and from the Head of Department of Psychology to develop support in the coming academic year, and the mentor noted that the initiative still has great potential. With the end of **sigma**/National HE STEM Programme funding, it is now up to the departments concerned, and the University to take this forward in a way they deem appropriate.

### **Liverpool John Moores University**

Structurally the Mathematics Resource and Support Centre is currently sitting within the Student Advice and Well Being service and benefits from the infrastructure it offers. As a result the Centre has made a flying start and has already attracted students through tried and tested publicity. Another advantage is that it offers the students a neutral place to come to for support. The site for the Centre is well placed for [the Faculties of] Health and Technology, close to nursing and engineering students. The project leader has already secured continued funding to the level of £10,000 annually, this will allow for a longer term strategy for the Centre. Future funding avenues may be Widening Participation monies linking to Access Agreement as the Centre will contribute to retention<sup>5</sup> and transition. It is well known that the mathematics and statistics support will get used a lot by students from non-traditional backgrounds for whom this University is a major provider.

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<sup>5</sup>Since the mentor provided her report, Liverpool John Moores University has highlighted the contribution of the Maths Resource and Support Centre to its retention strategy.

## Warwick University

Undergraduate usage had increased as expected towards the project deadline date and increased numbers of student mentors were accordingly being used. Undergraduates seemed happy with the advice given and pleased that the centre existed. Andrew Mead has a good rapport with his students and is more than capable of communicating at the appropriate level, and varying that level as required. Consequently I think excellent progress has been made. In 2012–13 the centre will be open throughout term time for undergraduates and this will provide much greater opportunity for word-of-mouth recommendations between students to use the centre. AM and his team will develop the centre based on experience and feedback and I believe it will evolve into a valuable resource for Warwick students needing advice and support.

I don't think there are any urgent issues although I would like to make some minor comments. I would recommend that the room is perhaps more obviously identified with QuBiC, the name by which the centre is to be known, perhaps by better signage or a "we are open" sandwich board. When I was present most undergraduates were using Excel for statistical analysis. It would help if a number of "How to ... in Excel" sheets were developed to save mentors from having to relay the same information to different students. Begging, stealing or borrowing resources from other **sigma** centres is recommended, preferably in a format that can be edited to suit Warwick students. A request for suitable material was made at the recent Hub meeting at Loughborough that I couldn't attend. I hope the Coventry/Warwick centres will maintain links.

## University of Wolverhampton

The team of providers are very committed to student support. We had a long discussion on ways of getting more students to engage, the merits and pitfalls of opening for repeat examinations, methods of evaluating the impact of the support, whether student names and student numbers should be recorded for visits, and ways to attract continued funding. The venue and appropriate funding have been secured at least until Easter 2013, and they have a plan in place to apply for further funding before the end of semester one. They are sharing location with existing student supports which should help embed the provision within the institution.

The only issues were sorting out pay rates with HR for the postgraduate tutors but this should be now be resolved. This led to a delay in the provision of funding for the purchase of computers but this is now going through and they will be available for the next academic year. They are also trying to organise tutor training with other centres in the Midlands regional hub of the **sigma** network.

In general I would have no concerns regarding this centre, the people are very enthusiastic and committed to improving the student experience and they will achieve their aims. It was a pleasure to meet with them and discuss how progress can be made to establish the centre on a more firm footing. We agreed to continue correspondence after the end of this project so we can carry on our discussion.

## Section 5

# Enhancing the community of practice: adopters' projects

This chapter concerns the work done by the **sigma** network as part of the National HE STEM Programme Practice Transfer Adopters project. The National HE STEM Programme launched the *Practice Transfer Adopters* initiative to make activities developed by the programme more widely available across the sector. Funding was available for HEIs to work with the leads of existing projects to transfer these into their own institutions.

The list of Adopter projects included *Enhancing a Mathematics Support Provision* which provided up to £10,000 to HEIs with appropriate tailored support using the experience gained through **sigma** regional hubs and funded projects. It was expected that each adopter would provide matched funding, possibly in kind.

### 5.1 Context and motivation

In 2011 **sigma** launched a competitive funding call within the overall Practice Transfer Adopter initiative; working with the MSOR Subject Centre of the Higher Education Academy, a similar call was made available to HEIs in Scotland and Northern Ireland (but for smaller amounts).. The aim of this funding was to provide support to HEIs with existing mathematics and statistics support to enhance their provision using the experience gained through the **sigma** regional hubs and via projects that **sigma** had funded. The six successful applicants were the Universities of Bath, Exeter, Leeds and Lincoln and Birmingham City and Cardiff Universities. In addition, St Andrews, Ulster and Robert Gordon Universities and Queens University Belfast received support through the MSOR-brokered extension to the remainder of the United Kingdom.

### 5.2 The supported projects

The specific schemes were varied in nature and included improvements to an existing drop-in support, the addition of a statistics advisory service, the implementation of a student ambassador scheme and the establishment of a repository for support materials. Where appropriate, an enhancement project was provided with an experienced mentor by **sigma** to advise on the planning and implementation of its aims and objectives.

### **5.2.1 University of Bath**

The project at the University of Bath used the Practice Transfer Adopters scheme to work with colleagues who have experience of providing mathematics and statistics support for students from vocational backgrounds. In the initial stage (January - July 2012), project staff sought guidance on a range of activities, including liaison with admissions and widening participation colleagues in Bath to determine the mathematics support requirements for this cohort. Working with departments accepting students from vocational backgrounds, modes of support (alternative provision, supplementary or enhanced teaching) for such students were identified and the need for pre-sessional materials, including distance support, was assessed.

### **5.2.2 University of Exeter**

Student support staff at the University of Exeter gained access to **sigma** consultancy support to advise on the development and expansion of the University's existing mathematics and statistics support programme and experience gained during a three-year pilot project. This internally-funded pilot project paid postgraduate research students in a variety of disciplines to mentor undergraduate students in mathematics and statistics. This programme had proved very successful so the Practice Transfer Adopters project looked at ways of sustaining and developing the project and at evaluating and assessing its impact.

The Practice Transfer Adopters project also supported the creation of a resource area for mathematics and statistics support as part of the University's virtual learning environment. At the outset there were some basic links to outside resources on the current site. Postgraduate students were paid to review existing mathematics and statistics resources and create a more user-friendly and informative area available to all Exeter students. They also met with staff and students in various disciplines to investigate whether specific subject-based mathematics and statistics resources could be shared more widely with staff and students.

### **5.2.3 University of Leeds**

The mathematics and statistics support service sought to enhance its statistics support provision by offering a new range of help services ranging from specific drop-in sessions for any student, to one-to-one booked appointments for undergraduate final year projects, postgraduates and research students. These appointments could be done remotely by using a facility such as Elluminate or Adobe Connect Pro. This enhanced support was delivered by the existing mathematics support tutor who specialises in statistics.

### **5.2.4 University of Lincoln**

The mathematics and statistics support service proposed to develop new tools to support greater numbers of educationally diverse students both within engineering and across the university. Creation of a central university mathematics and statistics support website combining this system of support with the support already offered by the Mathematics and Statistics Support Centre was seen to benefit all students studying on courses with mathematics or statistics content. Part of this website facilitated on-line diagnostics assessments for students to carry out in relation to topics covered in their studies across the University. This information would then be automatically relayed to the appropriate teaching staff and personal tutors so that targeted and timely interventions can be put in place. This might include direction to on-line resources, support from teaching staff and more formalised and directed support from the MSSC all tailored to individual

students needs. The website also made it possible to automatically generate a list of student mentors for each topic based on each individual students areas of knowledge. This list could then be disseminated to students so that they can access additional support from these mentors. This information can also be used by specifically trained staff in tutorials to encourage peer work. The suite of diagnostics tests provided data that can be used to evaluate the interventions, the results of which will be fed back to the **sigma** network.

### 5.2.5 Birmingham City University

Through participation in a project funded as part of the National HE STEM Programme by the Maths Stats and OR Network's Mathematical Sciences Curriculum Innovation Project (see page 19) the University had gained experience in providing a remote statistics advisory service using Elluminate. This had begun to raise awareness and demonstrated the need for such a service and, through additional staff training had enhanced the capability of the mathematics and statistics support centre in providing it. However, as awareness of the service increases further, it will require additional resources and training for it to become fully embedded as part of the University's student support arrangements.

The purpose of the Practice Transfer Adopters project was to develop the statistics advisory service further in order to provide better and more extensive support for students in quantitative data analysis through additional tutorial slots, developing and delivering generic statistics and quantitative data analysis workshops, teaching faculty liaisons and training faculty staff to provide embedded statistics support.

It was expected that this would lead to improved student performance and satisfaction. Measurement of usage of the service and evaluation of student feedback provided data which could be compared with the situation before the project began. Growing take-up of the service, positive feedback from students and the support of teaching faculty would enable a strong case to be made that the University should provide the resources to ensure the service became embedded as part of the University's student support arrangements.

### 5.2.6 Cardiff University

The University wished to access expertise and experience within the **sigma** network to

- Further encourage students from across Cardiff University to fully utilise the support available, especially in departments where engagement has proven difficult;
- Obtain increased feedback from students on the running of the service;
- Encourage more direct and accessible links between the service and Cardiff University students;
- Work with the students to further utilise the network of key contacts within Academic Schools already established across the University;
- Provide access to new forms of social media to assist in the marketing of the service;
- Support the ambassadors with training where applicable (e.g. large group presenting).

## 5.3 Mentors and advisors: Evaluation of PTA funded projects

In the following sections are self-evaluations or précis of reports from mentors<sup>1</sup>, which in almost all cases exemplify the energy and commitment of those involved in the dissemination of good practice. This demonstrates again the collegiality of this community of practice, a feature often remarked upon by outside observers. The recruitment process for advisors is outlined in Section 2.4. Those projects in institutions with sufficient pre-existing expertise that an advisor was deemed unnecessary were prompted to provide a self-evaluation.

### 5.3.1 University of Bath

The project is developing nicely at present under the stewardship of a highly competent project leader. Everything in the project plan is being done with some additions/modifications. The team is confident that this additional support programme for the targeted student cohort they put in place now will continue to develop and grow once the project has officially ended.

### 5.3.2 Birmingham City University

Our<sup>2</sup> Project is progressing quite well. We started late (1May) mainly because of communication issues (both internal and external). We have a consultant who is being very helpful. Myself and another part-time staff member have taken on a few extra hours. We also have identified a student to work for us but we are still negotiating his role. The big piece of work will be to take the workshops and leaflets we were given from Coventry and create faculty-based versions of them for BCU. We have started by contacting faculty staff and asking for their collaboration. We have received a positive response from three faculties but two others are proving problematic (we are aiming for at least three). The next stage will be to agree on a syllabus and map it against the faculty-based data sets. Our collaboration with the Business faculty may also lead to us producing self-paced learning materials in addition to PowerPoint presentations, stand-alone leaflets and their associated faculty-based data sets. All this development work may also benefit other institutions. A staff member is updating some leaflets for Coventry on a separate contract so we are hoping there will be some mutual benefits here as well. However, our main focus at the moment is SPSS workshops which serendipitously we are organising on behalf of HR and for which there is a big demand. There is also a possibility that we will be able to become accredited by IBM and offer them to externals (although this may affect our licencing if they are non-academics). In the process of doing all this we also hope that we will increase our capacity to provide statistics support after the end of the Project.

### 5.3.3 Cardiff University

Basically everything is pretty much set up for full implementation in September. I am in the process of purchasing some promotional materials (I'm currently haggling with

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<sup>1</sup>For the most part these are close-to-verbatim extracts with the variety of styles and voices preserved to maintain the immediacy and positive tone of the reports. The author reiterates his earlier acknowledgement in 1.6 of the value of these reports in preparing this document.

<sup>2</sup>It was not thought necessary to allocate a mentor to the projects at Birmingham City and Cardiff universities so the comments below are self-evaluations.

the supplier to get a good deal!) and I have been working with representatives from the students union to plan how to get the most out of the ambassadors. Two have already been determined, one of which will be responsible for overseeing the social media aspect of the promotion following on from a successful undergraduate project that I was involved with this year. I am also looking to coordinate with the manager of the university's new skills centre who starts next week.

#### **5.3.4 University of Exeter**

Good progress is being made with the electronic resources part of the project. The main question is to what extent the Business School will actually use some of the project materials as their second-year statistics provision is being revamped. However, success of the project (reviewing resources and improving interfaces) should be considered to be independent of this.

Central Exeter University funding has been secured for support within the mathematics subject area. Plans are in hand for discussions to be held between the Exeter team and the consultant regarding development and extension of this provision as well as evaluation and assessment of its effectiveness.

#### **5.3.5 University of Leeds**

The aims and intent of the project and the practice to be adopted were stated in the written proposal as:

- offering a new range of help services in statistical support: in place and staffed appropriately;
- making appointments remotely by a facility such as Adobe Connect Pro: technology is in place but not yet in regular use;
- monitoring by questionnaires and/or focus groups: established in April/May;
- Sustainability to ensure the adopted practice is embedded in the University before October 2012 : this mathematics and statistics support service is a mature service but some powers of persuasion might be needed to convince management (of the Library) that further money be allocated and also that academic staff throughout the University have a role to place in promoting and perhaps joining the service as tutors.

A presentation was made at the CETL-MSOR 2012 conference and appropriate publications are being prepared. The (internal) annual report of the provision in the Leeds mathematics and statistics support service will contain a section about the developments in the statistical work since 1 February 2012 which could go forward to influence senior management to provide sustainable resources.

#### **5.3.6 University of Lincoln**

The project will not be tested by students in July as was the aim. This is because the student intern has only recently begun authoring questions in the system and so there are not yet enough questions to properly test. In terms of rollout for testing at the end of August, and for student diagnostic testing in mid-September the project is on track. In order for ongoing evaluation once in action, a feedback and evaluation

plan needs to be drafted to ensure the collection of relevant measures and analysis techniques.

The system has real potential to change the way diagnostic and non-assessed summative testing in the Engineering course is carried out, and has implications in a wider Lincoln context. Students will

- have access to a larger bank of questions than they currently have access to;
- will be able to better track their progress and areas for improvement;
- have access to learning resources, including the 'student expert' system.

Moreover, the system is scalable to larger groups of students; staff will be able to deliver tests with more efficiency (once questions are written), and monitor individual students and whole cohorts progress through modules.

There is potential for impact on the wider mathematics and statistics support community, but differences in other universities' systems will mean that porting the system will not be hassle-free. Other institutions wishing to use it will need to ensure the systems can communicate with the databases, which is not an impossible task, but will need some resource to complete. Integration with a university's student records system is a key benefit of the system, and rollout without this feature is less desirable.

## Section 6

# Impact and Sustainability

In the years before the advent of the **sigma** network there were probably many in higher education who

... 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 (Kyle 2008).

The experience and achievements of the **sigma** network have ensured that mathematics and statistics support has become firmly embedded in UK Higher Education. Those involved have moved on to gather data on the way students use such resources and look for optimal strategies for the delivery of this support, providing convincing evidence that mathematics and statistics support has come of age.

This section describes the impact of the work done by **sigma** as part of the National HE STEM Programme and looks to the future of the innovations it has made. Although funding from the National HE STEM Programme ended in July 2012, the mathematics support community is committed to maintaining itself as an effective community of practice. The **sigma** regional hub co-ordinators have committed themselves to continue the work of the hubs, it has been confirmed that the CETL-MSOR conference will take place in 2013 at Coventry University and a steering group of active mathematics and statistics support practitioners has been established to continue the development of the **sigma** network.

### 6.1 Need for mathematics and statistics support

It is clear that for the foreseeable future, the need for mathematics and statistics support will remain. The growth in the **sigma** network in the period 2010–12 is very strong evidence for this:

- Five **sigma**-supported centres in 2010;
- 22 new **sigma**-supported centres running:
  - Five from 2010 funding round;
  - Nine from 2012 funding round;
  - Eight in Wales funded by the Wales Spoke of the National HE STEM Programme and trained by **sigma**.
- Two pilot regional hubs in 2010;

- Now six established regional hubs covering England and Wales;
- Support networks in Scotland and Northern Ireland stimulated.

Each centre is working hard to ensure that student support continues beyond July 2012 when **sigma** funding will end.

## 6.2 Inclusion in OFFA agreements

A highly significant impact of **sigma** is that resourcing of mathematics and statistics support services is beginning to be explicitly mentioned as a contribution to widening participation and retention strategies in the OFFA agreements of universities:

**Aston:** “We will increase the level of support in the Maths Drop-In Centre (part of the Learning Development Centre) by appointing student maths mentors following the model of our highly successful writing mentors and IT programming support”;

**Brighton:** “Mathematics and Statistics support available to individual students”;

**City:** “Enhanced academic tutorial support for W[idening] P[articipation] groups — New Activity”. Mathematics is included as “an area of traditional academic weakness”;

**Coventry:** “£105,000 for our Mathematics Centre”;

**De Montfort:** “Mathematics and English help: Our Learning and Study Support activity will continue, at a cost of £338,000 per annum, with additional targeted interactions for Year 1 students in 2012/13 (£40,000)”;

**Harper Adams University College:** “Augment the staffing within our learner support team, which provides support to students in receipt of the disabled students allowance, maths and numeracy support and also wider study skills support, which is available to all the University College’s students”;

**Liverpool John Moores:** “setting up of a maths centre in recognition that numeracy issues can be a barrier to entry”;

**Loughborough:** “Student retention measures [include] additional mathematics support”;

**Newcastle:** “Continue the delivery and further development of services that support students academic skills post-entry: Maths Aid and the Writing Development Centre”;

**Oxford Brookes:** “We established the Upgrade study advice service as part of our original Access Agreement to offer advice to students in study skills, maths and statistics and will continue our support in this area. The Upgrade service is available to any student who wants advice on improving their academic skills”;

**Portsmouth:** “Services such as the Academic Skills Unit, Maths Café, Disability Advice Centre, Counselling Service, Chaplaincy and Student Finance Centre work with our academic departments, to ensure that students have a positive experience of higher education which meets their particular needs”;

**Salford:** “Mathscope is a support unit for students experiencing difficulties with mathematics in whatever subject they are studying”;

**Sheffield:** “Continue to deliver the very successful programme of Maths and Statistics Help”;

**York:** “The York Maths Skills Centre has been set up to provide University-wide support”. The Centre has been particularly important in the University’s external profile – the report of the 2012 QAA Institutional Audit states that the review team found “the successful establishment of the Maths Skills Centre to support students across a wide range of disciplines” to be a feature of good practice.

## 6.3 Institutional evaluations of sigma

The **sigma** network has received many highly appreciative comments about the work it has done from institutions in which it has a visible presence and from elsewhere within the National HE STEM Programme.

### 6.3.1 Wales Spoke of the National HE STEM Programme

**sigma** has been hugely supportive of the Wales Spoke of the National HE STEM Programme. What has been most valuable has been the experience and expertise which **sigma** has shared enthusiastically with us at each stage of the process in relation to resources, materials, how to organise a centre, training of students who helped in the centres, and dealing with challenges faced by the support centres in their first year of operation. Without **sigma** we would have been unable to achieve the significant progress in Wales to date on making mathematics support available to more STEM students in higher education.

Alison Braddock, Regional Director of the Wales Spoke of the National HE STEM Programme

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The University of Kent has a strong commitment to broadening the range of learning support available to all students within the contexts of widening participation and student retention. The Student Learning Advisory Service (SLAS) in the Unit for the Enhancement of Learning and Teaching (UELТ) has a long and successful history of developing and delivering student-learning support. However, there was an increasing demand for mathematics and statistics provision and support. We are extremely grateful to **sigma** therefore for providing the funding which has allowed us to establish mathematics and statistics clinics in order to respond to students’ needs within SLAS and to offer students this support in a safe haven and a neutral environment. **sigma** has given the impetus, support, experience and expertise wherever and whenever needed to help set up, develop and establish the mathematics and statistics clinics.

The **sigma**/University of Kent joint-funded mathematics and statistics clinics have proved highly successful; the take-up rate has been excellent and the one-to-one appointments are clearly valued by students. As a result of the hard work and dedication of all those involved, these clinics have become an integral and vital part of student learning support at the University of Kent and consequently they will continue to enhance significantly the student experience of studying at Kent. The partnership with the School of Mathematics, Statistics and Actuarial Science will ensure the sustainability of the clinics as it makes use of current postgraduate students thus keeping costs manageable and affordable. SLAS in UELТ is committed to continuing to sustain the

expansion and development of the provision of mathematics and statistics support in future years and to promote the service to all students through continuing partnerships with Schools.

We are grateful and indebted, and would like to acknowledge **sigma**'s help and support in setting up the mathematics and statistics clinics — now an integral part of student-learning support at the University of Kent.

Mrs Allia M. Wilson, Manager of the Student Learning Advisory Service, University of Kent

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The University of Wolverhampton has recently set up a Mathematics Support Centre for all students in the University who have some mathematics or statistics in their course. This would not have been possible without the support we received from **sigma** to help set this up. Of most use to us was our mentor who was happy to share their mistakes, so we could avoid them and gave practical advice that will give us the best chance of sustaining our mathematics support programme. The small amount of funding that was available also helped convince the institution to set up mathematics support in the first instance and will give us a little time to prove our worth.

Ruth Fairclough, on behalf of the University of Wolverhampton

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### 6.3.2 University of Exeter

When I started working at the University of Exeter in 2009, part of my job role was to build on and expand the mathematics and statistics support available for students. I was immediately put in touch with the **sigma**-sw hub. Jane White and my other colleagues in the hub are an invaluable source of experience, creative ideas and support. Apart from events organised through the hub, I have also benefited from the research, training, resources and professional advice which **sigma** has provided over the past three years. Our mathematics and statistics support project has now received permanent University funding and I am sure this would not have happened without us having access to the **sigma** network.

Ruth Canter on behalf of the University of Exeter

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### 6.3.3 University of Warwick

The School of Life Sciences at the University of Warwick has recently set up a Mathematics, Statistics and Bio-informatics Support Centre, stimulated and motivated by a call for proposals from the **sigma** network. While the funding from **sigma** would not have been essential to the running of the centre, particularly given the focus the School of Life Sciences currently has on developing quantitative skills training for our students (both undergraduate and postgraduate), the call for proposals and subsequent events organised within the **sigma** network have stimulated the development of the centre, and provided access to a generous network of like-minded individuals willing to share their expertise and experiences in similar projects at other universities.

Given the discipline specific focus of our centre, and the concern about the increasingly quantitative nature of biology and lack of quantitative skills of many of those choosing to study in this area, I was slightly surprised to initially find relatively few resources focused on quantitative biology. The recent establishment of the Bio-mathematics Education Network is providing one route, in parallel with the continuing **sigma** network, to extend the current resources. As a professionally trained consultant statistician, I was also intrigued to see the emphasis towards mathematics more than statistics within **sigma**, though, again, recent discussions at the CETL-MSOR 2012 conference should lead to an increased emphasis, within the new **sigma** network, on the development of resources to support the provision of statistical advice.

Andrew Mead, Director, QuBiC (Quantitative Biology Centre), School of Life Sciences, University of Warwick

#### 6.3.4 The wider view from the National HE STEM Programme

The **sigma** Mathematics and Statistics Support Network, which has been funded since 2010 by the Mathematics Strand of the National HE STEM Programme through the IMA, has successfully built upon work undertaken previously by the collaborative Centre for Excellence in Teaching and Learning (CETL) in the provision of mathematics and statistics support based at Loughborough University and Coventry University. That work has enabled **sigma** to offer institutions across the HE sector thoroughly researched models of good practice in the provision of Support Centres for students struggling to cope with the mathematical and statistical components of their courses of study. Such centres have demonstrated that they have a vital role to play in enhancing the learning experiences of such students, notably in their transition to HE from schools, colleges and employment, along with their retention, achievement and employability. The funding has been used to broker the establishment of a national network of staff and institutions across the HE sector that is working collaboratively to share resources and experiences. This community of practice has been successfully nurtured through the provision of annual conferences, and the creation of six regional hubs to facilitate easier access for participants to dissemination events and training opportunities. Ample evidence was forthcoming of the strong commitment of those who have been actively involved in the provision of mathematics and statistics support at an institutional level in association with the **sigma** Network to sustaining the momentum that has been established. There is an urgent need for this to be complemented by the provision of funding — not just to sustain Support Centres in individual institutions, but to facilitate collaboration between them and the research that would provide the evidence on which future improvements in practice can be based.

Professor Harry Tolley, University of Nottingham, National HE STEM Programme Internal Evaluator

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The work of **sigma** is the perfect example of what we set out to achieve at the outset of the National HE STEM Programme. The mathematics support strand of the Programme was able to build upon the proven successful practices of Loughborough and Coventry Universities, and transfer and embed these more widely across the sector.

As a consequence, dedicated mathematics support provision has been established in more than 20 HEIs, and has been enhanced in at least a further ten. A key feature has been the activities of the **sigma** network which has allowed individual practitioners to come together as part of a national community to share learning, resources and expertise. This has been crucial in not only achieving the impact realised by the Programme, but also in aiding the personal and professional development of university staff; we have seen the influence of the network extend to other areas of collaborative activity across the Programme.

The importance of mathematics support has never been greater. The recent House of Lords review of STEM subjects within higher education highlighted that many students begin higher education courses with inadequate skills in mathematics, and that many institutions are, as a result, offering additional mathematics support. The role of **sigma** has been crucial in supporting such institutions and the legacy for the sector is clear to see; I am delighted that this has formed such an important component of the National HE STEM Programme.

Michael Grove, University of Birmingham, National HE STEM Programme Director

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It is hard to overstate the importance of the expansion of the **sigma** Mathematics and Statistics Support Network. Mathematics and statistics support is an essential part of any university. It is critical to a wide range of social sciences as well as professions such as nursing, an obvious benefit across all the STEM subjects and a boon to mathematics. By expanding the Maths Support Network, HEFCE and HEFCW have made a dramatic improvement to tertiary education. Mathematics and statistics support has now attained a critical mass and overcome the significant hurdle where universities worry whether offering such support is an indication of modest aspirations. The accepted position is now that it is a student's right to receive support with the mathematical content of their degree. The question for all HEIs should now be "How can universities provide a full range of qualifications and advance the widening participation agenda without maths support?"

David Youdan, Executive Director, Institute of Mathematics and its Applications

## 6.4 Lessons learnt

Four key findings emerged from the sigma work:

- The need for mathematics support remains as strong as it has ever been. Despite 'the Mathematics Problem' having been extensively discussed and reported on since the mid-1990s, the reality remains that many students, particularly but not exclusively, across the STEM disciplines find the mathematical elements of their degree programme a significant barrier to their success. The work of mathematics support is one way to alleviate this problem.
- There is a massive benefit to the HE sector in the existence of a network of mathematics support practitioners. With so many HEIs having only recently established mathematics support provision, there is a real need for inexperienced colleagues to be able to draw on

the expertise of colleagues from other institutions. There are also major efficiencies to be gained through adopting good practice and resources already developed and through such activities as shared training and staff development events.

- There is a strongly increasing demand for statistics support. The advent of **statstutor**<sup>1</sup> goes some way to meeting the needs of students in this area but much remains to be done. Unlike mathematics support where most of the issues of content raised by students could be called procedural — “I cannot understand how to apply this procedure” — queries regarding statistics might be called methodological — “how can I tell what is the appropriate statistical method in this situation” or “what data should I collect in order to test my hypothesis”. The qualitatively different nature of many statistics enquiries requires a different approach to statistics support; Patel et al. (2010) reviews the authors’ experience with statistics support at the **sigma**-funded centre at Sheffield University.
- The student constituency availing itself of maths support is broadening. A decade ago maths support was mostly directed at science and engineering undergraduates whereas nowadays maths support services see many students from business, social science or health-related disciplines and postgraduates as well as undergraduates. This rebalancing is likely to continue into the future, given the government’s wish to improve the numeracy levels of students studying arts or social sciences, as evidenced in recent contributions by the Minister for Universities and Science. The broadening is also happening in another dimension. Originally mathematics support was conceived for students in danger of failing, now, in addition to these students, it is being used increasingly by good students who are seeking to achieve the highest results possible.

The last two findings are related. A postgraduate student in a social science discipline seeking help from a maths support service is almost certainly looking for assistance with data analysis for a project report or dissertation and could well have been directed to do so by a supervisor.

Along with these two findings has come a recognition of a significant shortage of staff with the knowledge, skills and understanding to provide a statistics support and advisory service. Several additional projects funded by **sigma** began to address this shortfall; the Practice Transfer Adopters project at Birmingham City University is an excellent example of this. The experience gained by BCU and others needs to be disseminated as widely as possible beyond the end of the National HE STEM Programme funding. In addition, **sigma** supported a project exploring the feasibility of providing statistics support at a distance.

The broadening constituency of students seeking mathematics support also highlights staff and service development issues which will continue beyond the end of the National HE STEM Programme funding. Offering an effective mathematics support service for, say, nursing students, requires understanding of the ways in which these topics are delivered and applied in the subject area. While the technical and academic demands of this are modest, it can be a challenge to provide the necessary breadth of background within a small mathematics and statistics support operation. This resembles the perennial and under-researched question whether service mathematics teaching is best done by subject specialists or by mathematics staff.

In order to address these challenges, it is essential that a national network of those involved in the provision of mathematics and statistics support is maintained so that resources and good practice can be shared amongst institutions and the danger of wasted staff resource due to individual institutions developing their own solutions is avoided.

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<sup>1</sup>[www.statstutor.ac.uk](http://www.statstutor.ac.uk)

### 6.4.1 A note of caution

Alongside the broadening constituency of students availing themselves of mathematics and statistics support services must be placed some forthright criticisms of the approach to mathematics seen in some HEIs and of staff capabilities in some of these subject areas. For example (MacInnes 2009) contends that

The vast majority of university teachers [in social sciences] do not have the core skills in basic quantitative methods that would allow them . . . to teach these methods to undergraduates, were they called upon to do so.

Royal Society of the Arts, Manufacture and Commerce (2012) has uncomfortable things to say about the approach to mathematics seen in some HEIs:

But the level of mathematical knowledge required in higher education courses is not always apparent from entry criteria or module descriptions, often because institutions worry they will not fill their courses if they include higher mathematics qualifications as an entry requirement.

. While these shortcomings may guarantee a continuing supply of ‘customers’ for mathematics and (especially) statistics support services, it is not a situation with which this community is at all comfortable. For example, the comments on page 47 from the University of Wolverhampton continued:

There is a concern however. It seems mathematics support is now being provided by most institutions in UK HE. Is mathematics support being used as a ‘sticking plaster’ for poor course design? The learning curve some [science, engineering and technology] courses expect of their students is staggering with little or no thought as to whether the mathematics and statistics being taught is appropriate or useful, and many courses have an ever increasing mismatch between what is in their ‘introductory’ mathematics or statistics modules and entry requirements.

Almost everyone who has provided mathematics and statistics support will have seen teaching material provided to students by academic staff which is irrelevant, misleading, badly explained or technically inadequate or incorrect, sometimes in fundamental ways. Whether or not it has a duty or mission to press for improvements in the mainstream teaching of mathematics in universities is sometimes a matter of debate within this community. What is never in dispute is that the task is there to be done.

## 6.5 Looking to the future

To be eligible for **sigma** funding in either round an institution had to provide matching support, in cash or kind. Additionally, institutions receiving support from the second round of funding had to undertake to support the mathematics support centre in the academic year 2012–3. Hence there is an understanding at an institutional level that the centres will continue to operate in the academic year 2012–3. Current activities being undertaken by centres in looking to next year include securing better premises, gaining support from Teaching and Learning Committees and, of course, raising the visibility of their work. Typical of the efforts towards embedding is the funded centre at the University of Birmingham which has articulated its plans as follows:

The University proposes to enhance mathematics support provision across the University through the MSC [Mathematics Support Centre] to include peer support and mentoring, use of the MSC for outreach activities, pedagogic research and the delivery of bespoke mathematics provision within undergraduate programmes. The MSC will act as a focus for mathematics support within the University and will bring together members of staff to address issues in an integrated manner. Through embedding evaluation, the MSC will be used in a proactive manner to help understand where specific issues exist within University of Birmingham provision, and address these 'at source'.

### 6.5.1 jiscmail mailing list

Following an announcement at the 2012 CETL-MSOR conference, a JISCMail mailing list is now available at

`sigma-network@jiscmail.ac.uk`

This list is for anyone involved in cross-university mathematics and statistics support, including those working in support centres, and anyone with an interest in innovative teaching and learning support in mathematics and statistics.

The list is expected to be used to

1. announce events, resources and other items of interest to the **sigma** network;
2. seek help or advice from other members of the **sigma** network on general issues relating to the organisation, provision and evaluation of mathematics and statistics support. The list is not intended for 'problem solving' such as "What is the solution of this equation?", although it can be used to ask "Can anyone recommend a freely available online resource covering the solving of this equation?"
3. Share experiences of good practice or seek collaboration on new initiatives.

Participants in the **sigma** network are being encouraged to subscribe to this list, and to encourage their contacts to do likewise, recognising that there may not be much traffic and interest until a body of subscribers have registered.

## 6.6 Specific plans for 2012–13

### 6.6.1 Plans from support centres

When support centres were funded in the second round, it was a requirement that the host institution would continue to resource the centre after 31 July, 2012 when the National HE STEM Programme funding came to an end. Among the plans already made are

**Birmingham** has a detailed five-stage programme to deliver mathematics support provision to undergraduate students. Each of its five stages has a list of required activities, a success indicator and a timetable;

**Brighton** holding a large launch event for staff in September;

**Keele** Reopening in mid-October to offer longer hours of drop-in time and possibly self-study time when tutors are not present;

**Liverpool John Moores** planning a launch event with the Vice-Chancellor;

**Warwick** Launch of UG/Taught MSc Drop-In Centre from October 2012;

**Wolverhampton** will open for 15 hours/week from 24 September 2012.

### 6.6.2 Indicative plans from regional hubs

It is important to recognise that regional hubs were established without any undertaking regarding continuity beyond 31 July, 2012 from the host institution or elsewhere and that, by definition, hub coordinators are already heavily committed to delivery of mathematics and statistics support in their institution. Hence the planning and promotion of hub activities must be fitted into busy schedules without the expectation of additional resources. Nonetheless, each hub has identified people who are willing to take activity forward in 2012–13 to ensure that the regional hubs continue to operate as a vehicle for sharing good practice

Amongst the plans already formulated by regional hubs in preparation for the academic year 2012–3 are

- At least one half day “sharing good practice” meeting for practitioners involved in mathematics and statistics support, primarily to help newly-funded centres in nearby institutions to establish contacts and share emerging experiences;
- Hold a one-day developmental event focusing on a particular aspect of cross-university mathematics and statistics support, following the successful recent events “Statistics Support for More Ambitious Students” and “Mathematics Support for Nursing and Midwifery Students” which attracted sizable audiences from across the country to the host hubs and thus acted as a showcase for the **sigma** network;
- Instigate and attend meetings at institutions to promote the concept of mathematics and statistics support and **sigma** among institutions keen to find out more;
- Continue to co-ordinate dissemination of information to hub members and facilitate an annual forum in the hub; This continues a series of regional events during the National HE STEM Programme which has provided a welcome forum for colleagues in the region to discuss ideas and issues within mathematics and statistics support and has had some success in developing collaborative working between institutions.

## Appendix A

# Institutional Engagement

The table below demonstrates the sector-wide reach which the **sigma** network has had. The figures in the table below indicate the number of events (not the number of staff) that have been attended by staff from each institution. These data show that 87 HEIs from England and Wales, 6 from Scotland and Northern Ireland and 5 from the Republic of Ireland have engaged with **sigma** activities during the period of the National HE STEM Programme.

Table A.1: Institutional engagement with **sigma**

Institution	CETL-MSOR Conference	Central Event	Hub Event	Bid for funding
Aberystwyth University	1	1		
Anglia Ruskin University		3	7	3
Aston University	2			
Bangor University		1	1	
University of Bath	2	2	5	1
University of Bedfordshire	1		3	
Birmingham City University	1		2	2
The University of Birmingham	3	3	1	1
Blackburn College	1			
University of Brighton	1	3		2
University of Bristol	1			1
Brunel University	3	2	3	1
Buckinghamshire New University			3	
University of Cambridge	1		1	
Cardiff University	3	2	2	1
Cardiff Metropolitan University (UWIC)		1		1
University of Central Lancashire	3	1	1	1
University of Chester			1	
City University			2	
Coventry University	3	1	3	
University of Cumbria			1	
De Montfort University	2			

*Continued on next page*

Table A.1 – *Continued from previous page*

Institution	CETL-MSOR Conference	Central Event	Hub Event	Bid for funding
University of Derby		1		
University College Dublin	1			
Dublin City University	1	1		
Dublin Institute of Technology	1			
Durham University	1			
University of East Anglia	2		3	
University of East London			2	
The University of Edinburgh	1			
The University of Essex			7	1
University of Exeter	2	1	2	1
Glamorgan University	1	2	1	
University of Glasgow	3	2		
Glyndwr University		1	1	
University of Greenwich	3			
Harper Adams University College	2	1		
University of Hertfordshire	1		3	
The University of Hull	1			
Imperial College London			2	
Keele University	1	5	2	1
The University of Kent				1
King's College London		1		
Kingston University	1		2	1
Lancaster University	2			
University of Leeds	3	1	4	1
Leeds Metropolitan University	3		2	
University of Leicester		1		1
University of Lincoln	2	1	4	2
The University of Liverpool	2	2	2	1
Liverpool Hope University	1			
Liverpool John Moores University	2	6	2	2
London Metropolitan University	1	1	4	
London School of Economics	3			
London South Bank University			1	
Loughborough University	3	1	6	
The University of Manchester	2		1	1
Manchester Metropolitan University				1
Middlesex University			3	
National University of Ireland, Maynooth	2	1		
National University of Ireland	2			
Newcastle University	1			
University of Northampton	1	1		1
The University of Nottingham	3			
Nottingham Trent University	1			
The Open University	3		1	

*Continued on next page*

Table A.1 – *Continued from previous page*

Institution	CETL-MSOR Conference	Central Event	Hub Event	Bid for funding
The Open University in Yorkshire	1		2	
Oxford Brookes University	2		1	
Plymouth University	3		3	
University of Portsmouth	2	1		
Queen Mary, University of London	2		3	
Queen's University Belfast			1	
The University of Reading	2			
Robert Gordon University	1			
Royal Veterinary College			3	
The University of Salford	1		3	
The University of Sheffield	3	4	5	
Sheffield Hallam University	3	1	2	
University of Southampton	1		3	
Southampton Solent University			1	
South Bank University			1	
University of St Andrews	2			
Staffordshire University				1
University Campus Suffolk (UCS)	3	3	7	
University of Sunderland	3			1
University of Surrey		1		
Swansea University	1	1		
Swansea Metropolitan University		1		
Teesside University			1	
University Campus Suffolk	1			
University of Wales Newport	1	1		
University of Ulster	2			
University of the West of England	3		1	1
University College London	2			
The University of Warwick	2	5	1	1
University of Westminster	1		2	
University of Wolverhampton	2	4		1
The University of York	1	4	5	1

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