

## Preparing for the new mathematics A levels

Teaching of the new specifications for AS and A level Mathematics and Further Mathematics starts in September this year. As I write there are accredited specifications for AS and A level Mathematics for OCR A, OCR (MEI) and AQA.

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In the case of AS and A level Further Mathematics there are currently no accredited specifications and the awarding bodies are awaiting feedback on their submissions from Ofqual.

The FMSP has been running a programme of one day events for teachers to help with the preparation for the new courses. Most of these days took place in the autumn term and were attended by over 1100 teachers from around 850 state-funded schools/colleges. The days covered essential information about the new specifications, in particular the greater emphasis on problem solving, and other overarching themes. It is clear from these days and from other teacher feedback that there is need for further professional development to help colleagues prepare for teaching the new A levels, in areas such as using technology in mathematics, teaching use of a large data set, subject knowledge for mechanics teaching and developing problem solving skills at A level. The FMSP central team are developing a range of CPD opportunities including one day courses, online courses and extended courses, in order to address these areas. There is a section of the FMSP website devoted to the 2017 changes in which there are FMSP resources and links to information and other materials to support teachers, including a generic scheme of work for A level Mathematics produced by MEI.

[furthermaths.org.uk/2017](http://furthermaths.org.uk/2017).

During the autumn, Professor Sir Adrian Smith led a **Review of Post-16 Mathematics** in England and was asked by the DfE to consider the feasibility of everyone studying mathematics to the age of eighteen. The report has been completed and we are eagerly awaiting its publication to see the recommendations made. The review team focused on four areas:

- the pathways available to 16-19 years olds for continuing with mathematics, including functional skills, GCSE Mathematics, Core Maths, AS and A level Mathematics and Further Mathematics;
- factors that affect participation in mathematics post-16, including demand for mathematical skills by employers and higher education;
- attainment in mathematics at level 2 and level 3;
- school/college practices, including delivery, teacher expertise and availability, and the use of technology.

The review team also considered how recent curriculum changes and new funding models impact on provision and opportunities for students. The report is expected to highlight the differences in participation in level 3 mathematics between and within regions and make recommendations of how to address this variation.

*Kevin Lord, FMSP Programme Leader*

# Regional Events and Updates

## Professional Development

### Preparing for the 2017 A Level

During this academic year we are continuing to have a great emphasis on 2017 and the upcoming changes to the A Level Mathematics and Further Mathematics. Keep an eye on [furthermaths.org.uk/2017](http://furthermaths.org.uk/2017) for information about the new A Level as well as support and updates on professional development opportunities.

The change from a modular course to a linear course may seem daunting. There will be a lot of support available throughout the North-West to help you not only prepare for teaching a linear course but also create a learning environment that focuses on developing problem solving skills and embedding technology into the curriculum. A number of the events that we're planning to put on are mentioned below but please don't hesitate to get in touch if you'd like us to support you and your department in any of these or other areas relating to the new A Levels.

We've already put on four **Preparation for the 2017 Mathematics A Level** CPD days with one more to come in Bury. These have been very well received and have given us the opportunity to talk to teachers about priorities for planning our Network Meetings and CPD for the summer term.

Following on from the meetings above and in anticipation that the specifications will soon be approved, we're planning **free twilight network meetings** in a number of areas in May and June on themes such as:

- Incorporating Problem Solving into A Level classrooms
- Using digital technologies in mathematics teaching
- Use of data in Statistics
- Planning for Further Mathematics

Other CPD events in the North West include:

#### Teaching First Year A Level:

This is a 2-day CPD with the first day in the summer term. It will look at the key concepts in the new First Year of Mathematics A Level and well as discussing a range of approaches to teaching the content effectively and engagingly, with particular reference to the overarching theme of problem-solving and embedding technology into the curriculum. There will be options to look at the compulsory Mechanics and Statistics parts of the course.

#### Further Mathematics Conference:

Our 2-day Further Mathematics conferences held in Manchester have proven to be extremely popular. This year we'll be concentrating on the AS level Further Mathematics. There'll be a choice of session to attend including the Further Mathematics core topics, GeoGebra for AS Further Mathematics, Decision and Discrete, Further Mechanics topics, Further Pure topics, planning your Further Maths Curriculum and more.

#### Embedding Problem Solving in the new A Level:

A full day course looking at a number of problem solving resources, how to adapt exercise and exam questions and ways of embedding problem solving to enhance your every day teaching.

#### Use of Technology in the new A Level:

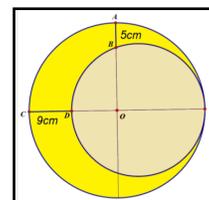
This is one-day course exploring the requirement for integrating technology into the teaching and learning of the new A level courses (first teaching September 2017). The course will include a session on using technology to explore the large data set in Statistics.

The FMSP is committed to providing Key Stage 4 students a range of extension and enrichment activities to experience in order that they will consider undertaking further study in mathematics. **Extension and Enrichment** and **New Higher Tier GCSE Content** courses are both organised nationally.

## Key Stage 4 Events

These events are provided free of charge to KS4 teachers from state-funded schools, colleges and academies. In the northwest we continue to provide teachers the opportunities to participate in these courses. This year we held the 2-day Extension and Enrichment course in Manchester and Cumbria. The event gives teachers the chance to engage with some interesting mathematics and to consider the approaches they could use with their students.

*Right: An example from the problem solving session. A symmetrical yellow crescent is formed from 2 circles as shown with  $O$  being the centre of the larger circle.  $AB=5\text{cm}$  and  $CD=9\text{cm}$ . What are the diameters of the two circles?*



New Higher Tier GCSE Content Courses focus on two topics, one developing reasoning and proof and the other exploring functions and graphs. These will be held in the region in the summer term. Please consult the regional events page for dates and venues.

# Regional Events and Updates

## Professional Development

### A new approach to PD

Whilst we wait to hear from Ofqual and the awarding organisations about the precise format of the new A Levels in Mathematics and Further Mathematics we have taken the opportunity to trial a new approach to professional development for teachers, one that is somewhat less formal in nature but that we hope will prove equally fruitful.

Previously, we have put on courses for teachers focusing on specific areas such as Mechanics, Statistics and AS Core Maths. We will continue to offer these low-priced (and often free) routes to improving subject knowledge and pedagogy for teachers, and our existing courses will be modified to reflect the structure and content of the new A-Levels. As mentioned elsewhere in this newsletter, we already have days for the new version of our 'Teaching AS Core Maths' two-day course, and others will follow in due course.

Teachers have often commented on the value of student events (such as enrichment or problem-solving) for their professional development, so we decided to focus this year on opportunities for CPD specifically through student events. By mid-March 2017, four new enrichment events, attended by approximately 200 Year 12 students, will have taken place in Manchester and Liverpool. These have grown out of our existing courses in Mechanics 1 and Statistics 1. We have always encouraged teachers to take away ideas for teaching resources from our sessions and trial them with students. In fact, our two-day courses build these 'gap' tasks into their structure. So for these events, we decided that we would flip things somewhat and host student-centred events, inviting teachers along to engage with students as they undertake the activities that we have previously used with teachers on the traditional courses.

Each enrichment day is based only on content that students will be familiar with from GCSE and from early AS work. Thus the statistics tasks we present use and develop basic ideas in probability and representational statistics, to both enrich and hopefully develop initial understanding and, importantly, point the way to future study in the subject, such as distributions and hypothesis testing.

In Mechanics, we make some initial assumptions about students' grasp of basic kinematics, but little else. The activities we use, involving planning and design as well as more traditional 'mechanics calculations' similarly aim to cement students' understanding, outlining the future development of the subject should they choose

to pursue it (such as in Further Mathematics, for example, or possibly in engineering contexts at University or in work).

Average Wage 1

<b>Data Limited</b>	"The average employee in Data Limited already makes £80 000, so there is no need to give raises this year" says one of the company's senior executives.
"The average employee in Data Limited makes £40 000. That is a decent salary" says the employment interviewer for Data Limited.	"The average employee in Data Limited makes only £15 000 a year. That is a disgracefully low wage" says the union leader.

All the above statements are true.  
There are 11 employees in Data Limited, divided into 4 salary levels.  
**What could their wages be?**

*Above and below: Sample carousel activities from the new Statistics enrichment events*

**Changing the Mean and Standard Deviation**

1. Which set of numbers has the greater mean? Explain.

2. Can you find one set with the same mean but a different standard deviation? Explain.

3. The job of a statistician is to describe data. What are the mean and standard deviation of the data in each set?

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We have made a deliberate attempt to make every session active, with students being encouraged to generate data, build simple models and attempt to understand the implications of what they are constructing, as opposed to carrying out routine calculations. We also make every effort to emphasise the importance of these subjects in further mathematical study, employment opportunities and beyond.

# Regional Events and Updates

## Enrichment for Students

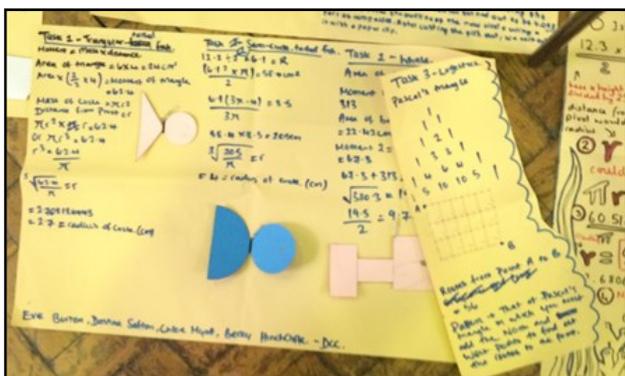
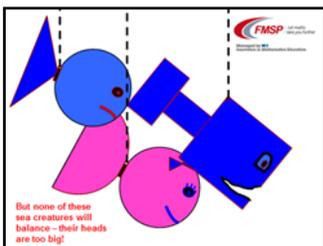
### NW Enrichment Events

These events come in two different guises:

Firstly we hold a number of large external events usually held at the three FMSP NW Universities of Liverpool, Manchester and Lancaster. For example, in December Year 11 students were invited to the Taking Maths Further events held in Manchester and Liverpool. This large enrichment event invites students to take part in some engaging but probably unfamiliar problems in small groups. We often use resources from the well-established Fun Maths Roadshow [maths.liv.ac.uk/lms/funmaths](http://maths.liv.ac.uk/lms/funmaths). Following this they engage with a problem-solving session. This year students are challenged to produce a hanging 'mobile' containing fish that balance horizontally, and subsequently calculate solutions to problems in quality control and logistics based on the production of the mobile. The intention is to introduce students to



Left: The hanging fish 'mobile' task. Students work in groups to produce a poster of their work.



problems with a real life context, whilst at the same time highlighting and engaging their interest in applied mathematics topics that they will study if they choose A Level Mathematics.

In the afternoon Katie Chicot (pictured right), from the Open University gave a talk on infinity that was enjoyed by all the students. The day finished with a competition in mixed-school groups.



Schools target students for these events carefully; we particularly encourage girls to attend, and also those students of known ability who may be thinking of choosing other subjects post-16.

All of the content of these days is replicable in school: the roadshow can be purchased quite cheaply; departmental meetings could be used to come up with a themed problem-solving session (You Tube can provide an almost endless supply of stimuli and contexts on which to base ideas).

Secondly, we hold a number of internal events involving perhaps just one class, and hybrid events, where a small number of schools in a local area host an event. These can be enrichment or booster sessions. The latter are aimed at students in Year 10 or 11. They are typically organised in a particular school and aim to give the students activities that will deepen their understanding of a topic and increase their confidence.

We usually start with some starter questions that are engaging but unfamiliar, then we move onto a couple of sessions covering GCSE topics but in an usual way.

The final session is then a quiz when the students work in groups to answer questions on the topics cover and some general problem solving questions. At all the student events the teachers are given access to the materials used and are encouraged to integrate them into their own teaching materials.

#### Typical quiz questions:

1. The point  $(-3, -4)$  is the turning point of  $y = x^2 + ax + b$  where  $a$  and  $b$  are integers. Find the values of  $a$  and  $b$ .
2. There are four pairs of positive integers  $x$  and  $y$ , that give  $x^2 - y^2 = 105$ . Find them.
3. The ratio of girls to boys at a party is 3:4. If 6 girls leave the ratio is changed to 5:8. How many boys were at the party?

Local FMSP Area Coordinators and Associates can run workshops and presentations at no cost, and we can help provide versions of competitions for use in schools.

# Regional Events and Updates

## Enrichment for Students

### Florence Nightingale Day

One of the FMSP's key ongoing projects is to investigate the gender gap in A Level Mathematics participation, and encourage initiatives that encourage more girls to continue their study of mathematics beyond GCSE. More information can be found on the FMSP website at: [furthermaths.org.uk/encouraging-girls-maths](http://furthermaths.org.uk/encouraging-girls-maths). In particular, please take a look at our briefing document "**Girls' Participation in A level Mathematics and Further Mathematics**" if you'd like some hard copies of this, please contact your local Area Coordinator. Over the coming months we'll be working with local Maths Hubs and other interested parties to develop our strategy to encourage as many girls as possible to get excited about mathematics and think about choosing mathematics as an A Level choice.

In the North West, the FMSP supports a variety of events. Our two **Taking Maths Further** events for able Year 11 students, held in Manchester and Liverpool during December, have mostly female presenters and we particularly encourage schools to send girls to these events. In Lancaster, the FMSP supports the University's annual **Florence Nightingale Day** event aimed specifically at female mathematics students in Years 11, 12 and 13. This year's event, in January, mixed presentations by female mathematicians with a -tricky quiz. Over 75 girls, mostly in Year 11, attended with their teachers to hear talks by young female academics on how mathematics is used in biology and how mathematics enables us to understand more about the sun. Feedback was excellent and the event will run again in 2017-18.

### Key Stage 5 Problem Solving

For the fourth year running, the FMSP in the North West is running a series of one-day problem-solving events aimed at A Level Mathematics students and their teachers. Each term, one Year 12 and one Year 13 event runs in Lancaster, Liverpool and Manchester.

Our Year 12 events are designed for all students of mathematics, not just "high-flyers". Students do not need to be studying Further Mathematics in order to attend these days. The main aim of our Year 12 problem-solving days is to give students and their teachers some experience of tackling mathematical problems as well as show them some exciting questions and investigations. Each term's day is independent of the other terms' days - some schools

and colleges will come along for all three days, but most just come to one or two. FMSP's summer term Year 12 event is designed in particular to give an introduction to mathematical modelling. FMSP's Year 13 students are also designed to be accessible to all students, but they're particularly helpful for those who might be thinking of sitting one or more of the university admissions tests for mathematics, such as the Mathematics Admissions Test (MAT), the Test of Mathematics for University Admission (TMUA), the Advanced Extension Award (AEA) or the Sixth Term Examination Papers (STEP). The first term event uses questions from these papers as examples of intriguing problems, the second term event is particularly aimed at those thinking of sitting STEP or AEA in the summer, and the third term event is specifically designed as a STEP and AEA preparation and revision day. The Year 13 days also include briefings for teachers on the style and format of MAT, TMUA, AEA and STEP.

So far this academic year, well over 100 students have attended at least one of our problem-solving days, and we look forward to welcoming many more to our third term events in Lancaster, Liverpool and Manchester.



We'd like to particularly emphasise the beneficial effects for teachers' professional development of attending these sessions with their students. Many teachers who have attended an event alongside their students have commented favourably on the help the days offer in assisting them to offer meaningful help to their students - particularly those who may be sitting STEP, MAT, AEA and/or TMUA. In a similar fashion to the FMSP's initiatives in Statistics and Mechanics CPD, these events are strongly influenced by courses in problem-solving for teachers and we hope they have been of use in overcoming some of the fears maths teachers understandably have in getting to grips with the content of these advanced mathematics papers.

In some parts of the North West, we run regular weekly problem-solving sessions. If you'd be interested in helping set up some classes in your area, please get in touch with Abi, James or Martin.

# Contact the North West team

## Martin Bamber

Martin has been involved with the FMSP as an Area Coordinator since 2006. He was a classroom teacher of mathematics at a school in Oldham for 10 years, before moving to special education, working with students with moderate learning difficulties. Before taking up his present post, Martin worked as a Head of Mathematics in a comprehensive school in Hong Kong. He is currently completing a Masters degree in Education.



*Left: Abi Bown and Martin Bamber, North West Area Coordinators based at Manchester and Liverpool universities*

## Abi Bown

Abigail has been an Area Coordinator based at the University of Manchester for over 10 years. Before that she taught at a Sixth Form College for 10 years after working in an 11-18 school and travelling the world for a couple of years. She will (hopefully) complete her Masters in Education this year.

## James Groves

James has been an FMSP Area Coordinator, based at Lancaster University, since 2012. Before then he was a tutor for the FMSP and its predecessor the Further Maths Network. Originally from Chepstow in South Wales, he studied maths at Cambridge before coming to Lancaster to do a PhD in the late 1990s. He's a member of teaching staff at Lancaster and is presently Undergraduate Admissions Tutor for the Mathematics and Statistics department.



## Sue Harkness

Sue has been involved with the FMSP for several years as a tutor, an Associate and currently as an Assistant Area Coordinator. Prior to this she taught mathematics in a variety of 11 to 18 schools in the Liverpool area before becoming a school improvement officer for Liverpool City Council. She has also been involved with PGCE and Teacher Subject Specialism Training at Liverpool Hope University and LJMU.



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## North West Event Pages

**For teachers:**  
[furthermaths.org.uk/NW\\_CPD](http://furthermaths.org.uk/NW_CPD)

**For students:**  
[furthermaths.org.uk/NW\\_enrichment](http://furthermaths.org.uk/NW_enrichment)

