FURTHER MATHEMATICS SUPPORT PROGRAMME

Autumn 2016
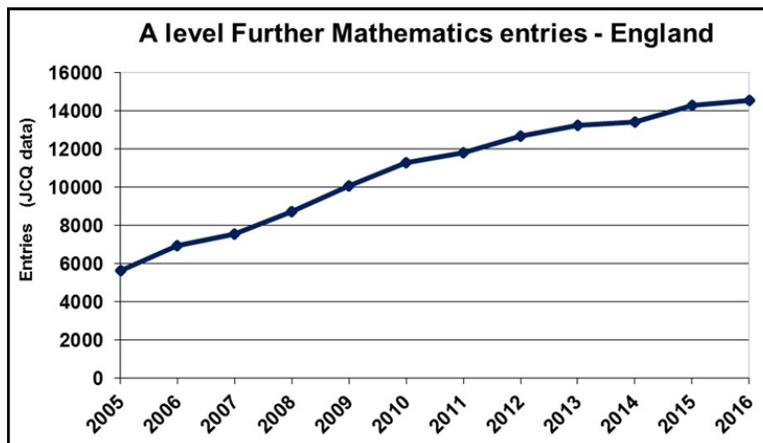Yorkshire and the Humber Regional **NEWSLETTER**

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FMSP | *Let maths take you further*

Entries for Further Mathematics increase for 13th consecutive year

This summer over 92000 students completed A level Mathematics. While entries for many A level subjects were down this year due to a smaller Year 13 cohort, A level Mathematics entries remained stable. Encouragingly entries for A level Further Mathematics increased by 1.8% to over 15000.

Total entries for AS levels were down 13.7% compared with 2015, largely as a result of fewer AS entries in reformed A level subjects. AS Mathematics and Further Mathematics entries decreased by 1.6% and 1.1% respectively. The FMSP believes these are important qualifications in their own right as well as being stepping stones to full A level. Studying the additional mathematics content in AS Mathematics or Further Mathematics provides useful preparation for higher education and employment. The FMSP is working to encourage schools and colleges to retain AS levels for mathematics once the new specifications start in 2017.

Prof. Adrian Smith has been asked by the government to review the feasibility of all post-16 students continuing to study mathematics to age 18. His review is due to report before the end of 2016. The FMSP will support schools/colleges to implement the recommendations so that all students have the opportunity to study an appropriate mathematics course in the sixth form.

First teaching of the new A levels in mathematics is one year away. Draft specifications and sample assessment materials were submitted to Ofqual in June. Ofqual has asked all awarding organisations to make changes and resubmit. Depending on the extent of these changes it is unlikely that any specifications will be accredited before November 2016. Look out this autumn for 40 free, regional one-day courses on planning and preparing for the new linear A levels. These days will look at the themes that run through the new specifications, how to plan a linear scheme of work, and ways to teach Further Mathematics alongside A Level Mathematics.

Kevin Lord, Programme Leader

Regional Events and Updates

Professional Development

An introduction to the teaching of A2 Core Mathematics

This two day course focused on increasing subject knowledge and providing ideas and resources for teaching A2 mathematics. The course leaders were Tom Button and Yvonne Croasdaile. Twelve teachers from across the region attended this course at the National STEM Centre which covered Trigonometry, Exponentials and Logarithms, Differentiation and Functions on day 1; then Integration, Applications of Integration, Algebra and Vectors on day 2. Teachers were asked about the most useful aspects of the course and here are some of their comments:

- Seeing new ways of teaching different techniques
- Just experiencing A2 content in anticipation of teaching it next year
- Ideas of how to introduce topics
- Geogebra as a teaching tool for students to visualise abstract concepts
- Learning about geogebra in an interesting way with real exam questions

An Introduction to the Teaching of A2 Core.

New Higher GCSE Content

The course, hosted by Canon Lee School in York, focused on teaching the new Higher tier content, enabling mathematics teachers to challenge KS4 students, and develop student understanding and problem solving skills.

Participants worked on addressing the challenges of effectively meeting the new requirements, and received access to new teaching resources. The course leaders were Tom Button and Jean Smith. Thirteen teachers attended this one day course which Canon Lee School in York hosted. Teachers commented that some of the most useful aspects of the day were:

- Having time to look at new curriculum and investigate ideas for teaching new specification
- Excellent presentations and useful resources (booklets and online resources)
- The chance to try the questions and put yourself in the shoes of the students
- The introduction of new topics such as frequency trees and the added element of problem solving
- Ideas for teaching the new content

Key Stage 4 Enrichment and Extension: Developing reasoning and proof at GCSE

This new one day course was piloted in Leeds in June, led by Carol Knights and Tom Button, and was attended by 24 teachers. Reasoning and proof become much more challenging in the new GCSE, and this course provided an opportunity to consider what we mean by proof, the stages of development that students must go through, and some of the different types of activity we can use to develop skills for proof and reasoning. It concluded with a look at how the ideas develop at A level, which was particularly useful for teachers in 11-16 schools, who welcomed the opportunity to see the 'bigger picture' and where GCSE skills fit into that. The day was well-received by the teachers that attended, and will be offered at different venues in the autumn term.

KS4 Problem Solving

This was a one day course at the National STEM Centre focusing on the development of problem solving skills. Since 2010 assessment objectives specifically designed to test problem solving skills have been included in GCSE Mathematics; the new GCSE criteria recognise the increasing importance of Problem Solving. The course leaders were Tom Button and Jean Smith. Twelve teachers attended the course which aimed at providing teachers with strategies to address the problem solving assessment objectives and encouraged them to use problem solving activities designed for KS4 students which they had chance to use and assess during the day. They were also provided with some initial strategies to help students make the transition from GCSE to AS level mathematics. Comments from teachers included:

- Looking at GCSE problems & discussing with colleagues
- Resources/ideas for problem solving activities. Discussion around strategies for introducing problem solving activities into schemes of work
- Resources and shared ideas for use in the classroom

Introduction to the teaching of A2 Further Pure

A day's course suitable for teachers about to start teaching A2 Further Pure was held at the University of Leeds in July. The topics covered included Complex Numbers, Differential Equations, Maclaurin & Taylor Series, Polar Coordinates and Calculus involving inverse Trigonometry and Hyperbolics. These topics are in the present Edexcel FP2 syllabus and are also in the prescribed part of the 2017 A level Further Maths. There was also an emphasis on the use of ICT.

Regional Events and Updates

Enrichment for Students

Maths Feast

The Maths Feast is an exciting competition for students in year 10 testing Mathematical, Communication and Teamwork skills. There were five rounds this year including a True/False round; Countdown round; Complex Numbers Comprehension round; Pentominoes Investigation round and a Relay round. Certificates were given out for the winners of each round and the best teamwork.

The Hull event was at Winifred Holtby School and sixteen teams took part. The York event was at Bootham School and eleven teams took part. The Scarborough event was at Scarborough's University of Hull Campus with seven teams taking part.

In Leeds the event took place at Lawnswood School with eighteen teams taking part. In Wakefield the event took place at Horbury Academy with eleven teams taking part. The Halifax event was at Halifax Academy and seven teams took part. The Huddersfield event was at King James's School and ten teams took part. The Doncaster event was held at Hill House with seven teams and a further eight teams took part in the Sheffield heat at the University of Sheffield.

Teams that were unable to take part in the Maths Feasts in March were offered a second chance to enjoy the competition, by holding an event in their school entitled Summer Snacks, which covered the same sessions, but provided an opportunity for even more students to be involved. At Farnley Academy in Leeds, over 50 year 10 students enjoyed the event, particularly the 'unseen' round where they grappled with Complex Numbers – a topic they had never seen before. Canon Lee School in York also held a Summer Snacks event at their school in May with 52 students taking part. They particularly liked the Pentominoes Investigation.

Taking Maths Further

The year 10 Enrichment Day was hosted by The University of York and took place on 4th July with 125 pupils and their teachers from 8 schools attending. The pupils attended 3 out of a possible 6 workshop sessions: Game Shows, Scams and how not understanding maths could kill you Fun Maths, Maths in the Movies, The Amazing Properties of the Mobius Strip, Climbing the Career Ladder, Codes and Cryptography

All pupils attended the final lecture which was 'Patterns and Predictions' by Colin Wright. Some comments from teachers:

- Good variety, sessions were a good length with plenty to do. Pitched to the right level
- A good range of activities, well pitched and not overly long but with enough time to consider the subject. Appreciating practical implications of using maths
- The connections to topics just touched on in the curriculum and how this evolves
- Good range of subjects and nice that group was split so they could explore all available and discuss. Getting them to real life jobs that involved maths
- Maths and movies - strong links between further maths and possible future careers. Longer sessions, more activities, move more
- Fun Maths - they enjoyed it the most and were asking lots of questions

There was also a KS4 enrichment day at the University of Huddersfield in July. Eighty five students and their teachers from six schools attended the day. They took part in 3 out of 5 workshops: Game Shows, scams and how not understanding maths could kill you! The Möbius strip, Mathematical problem solving, When is a straight line not a straight line – Exploring alternative geometries and Fractals.

All students attended the final lecture on 'The Mathematics of Juggling'. Some comments from teachers:

- The workshops show pupils how maths is used in lots of situations and circumstances
- The day was well organised with friendly and helpful staff
- Good interactive sessions
- Helpful knowledgeable staff. Lovely student ambassadors, sessions very engaging

Fun Maths

A similar enrichment day was held at the University of Sheffield on the 24th June.

130 year 10 students and their teachers from six schools attended three different workshops from

- Making Sense of Infinity – Sarah Browne
- Mathematics & the Movies – Tom Button
- How do we count holes – James Cranch
- Advanced Counting – Fionntan Roukema
- Gambling with Maths – Ria Symonds

The day was completed by all students attending an entertaining presentation by Katie Steckles on the Hidden Maths of Technology and the positive feedback from staff received ensured a similar event will be held next year. *Contd...*

Other News and Events

Supporting Students with STEP, AEA and MAT

The University of York provided a STEP course for year 13 students and a Problem solving course for year 12 students. Students attend fortnightly meetings where they received help with preparation for interviews, mock interviews and discussed ways of tackling Problem Solving and answering STEP questions from past papers. Many Thanks to Niall Mackay for helping the FMSP provide this course, to Henna Koivusalo for running the Year 13 classes and to Alan Haynes for the Year 12 classes.

The classes were a great success and will start again in November. For more information please contact Jean Smith **jeansmith@furthermaths.org.uk**

The University of Sheffield also continues to provide weekly MAT & STEP preparation courses for year 13 and enhancement problem solving sessions for year 12 which are becoming increasingly popular. These sessions start again in September and you can find details on the SYMH website **www.symathshub.org.uk/index.php/post-16-item/40-university-of-sheffield** or contact Pete Sides **petesides@furthermaths.org.uk**. Also Dr Elliott ran STEP classes throughout the year at the University of Leeds.

Problem Solving Classes

We have held a year 12 group meeting approximately fortnightly at the University of Leeds throughout the year and also a group in Bradford. These sessions are for students who enjoy challenges in their Mathematics.

Throughout the year both classes have covered topics such as Combinatronics, Coordinate geometry, Curve sketching and Sequences & Series. Also a year 13 group met approximately once every two weeks in Halifax. This group looked at problems relating to various topics including Logic, Induction, Vectors and Complex Numbers. One student comment was 'Thanks for making me a more confident mathematician. I enjoyed every session'.

Consider the sequence generated by the iteration

$$x_{n+1} = \frac{x_n^2 + 2}{3}; n \in Z^+$$

a. Check that if $x_1 = 1$ then all terms of the sequence are identical
b. Identify all starting value(s) which produce a series of identical terms.
c. Are there any starting values which produce a series of alternating terms (i.e. of period 2)?

Year 12 Problem Solving Student/ Teacher Conference

Forty two students and nine teachers attended the above conference at the University of Leeds in July.
The problem solving mindset was a recurring theme throughout the day.

Some of the sessions involved teachers and their students working together on problems and some sessions had the teachers and students working separately.
On their own, the students concentrating on explaining their solutions to other students and answered some questions from the Liverpool Fun Maths Roadshow.
From the feedback it was clear that the students enjoyed solving the problems in groups, and appreciated advice on how to start to tackle a question.

KS5 Network Meetings

The Hull and East Riding KS5 Network group met on 11th March at Wilberforce College with a focus on The New A level with a presentation given by Jean Smith and then again on 8th July at Wyke College with teachers discussing the new draft SAM's.

The York KS5 Network group met on 27th April at Fulford School with a focus on The New A level with a presentation given by Jean Smith and then again on 20th July with teachers discussing the new draft SAM's.

The Hull KS4 Network group met on 9th March at Kelvin Hall School when the focus was 'ICT to support the teaching of Mathematics'. This session was led by Betty Garfoot.

The York KS4 Network group met on 15th March at Archbishop Holgate school. Rob Eastaway of Maths Inspiration was our guest speaker for the afternoon with his 'The Pitfalls of Mathematical Modelling' talk. There was also a meeting on 6th July when Alan Easterbrook led a session 'Where's the Maths – taking learning outside'.

The South Yorkshire network group met on July 8th at Maltby Academy where the focus was the new A level. A presentation made by Pete Sides was followed by a discussion of implications and next steps.

Both the **Calderdale** and **Bradford** groups met to discuss the new A level information. The information that was available at the time was distributed and some time was spent looking at the prescribed mechanics parts of the new syllabus and also at the links between some pure mathematics and statistics. Two of the teachers had attended an online session from Edexcel and shared some of the information given.

The **Wakefield and Kirklees** KS5 Network group met on 1st March at Batley Girls' School and focused on the new A level and the information that was then available. There was also an opportunity to look at some of the MEI Maths Item of the Month materials which provide some excellent problem solving resources for both AS and A level and the Higher Tier of GCSE. Teachers felt this was particularly useful given the increasing focus on problem solving.

The **Leeds** KS5 Network group met on 7th July at Horsforth School, focusing on the new A level draft specifications and sample assessment materials. Sheila Eastwood delivered a presentation about some of the key points, then there was an opportunity for discussion. This was followed by a focus on the SAMs with an opportunity to explore the different ways that the same topics will be tested at AS and A level, and also to consider the differences between exam boards.

Other News and Events

Rob Eastaway Session

We held a regional meeting in Leeds where Rob Eastaway presented a talk on Mathematical Games – Problem Solving without the pain. He introduced a variety of games, some of which a primary school pupil would enjoy playing but could produce challenge for a sixth form student.

> **Diffy.** Put any four numbers at the corners of a square. Write the difference between each corner pair in the middle of the side, join to make a diamond and repeat the 'diffy' procedure until you have a square of zeroes. What's the maximum number of squares you can generate (including the first and the final zero square)?
>
> Show that all diffy squares can be reduced to an equivalent diffy square that has the form: [0, 1, a, b].

It was well received and many teachers said how much they had enjoyed the afternoon.

Fun Maths—Continued

During the summer term, a number of Fun Maths sessions for year 7 pupils were offered to 11-16 state funded schools in the YH1 region. The sessions used activities written by Liverpool Mathematics Society which included mathematical problems, puzzles and logic questions. The puzzles were laid out on tables in the hall or other large space and pupils moved around the room tackling the puzzles in any order they chose. Each pair of pupils had a customised response sheet which was initialled by a teacher as each activity was successfully completed. Those schools which chose to accept the invitation for a session to run in their school were pleased with the outcome.

A number of schools in the YH3 region took up the offer of a day of in school enrichment, with both year 7 and year 8 pupils engaging enthusiastically with the problems and puzzles of the Fun Maths Roadshow, in a relaxed and focused atmosphere. They also took part in a workshop entitled 'Magic Maths' where they were introduced to the magical properties of numbers such as 1089. In the afternoon year 10s had the opportunity to get their teeth into some problem solving activities, and at the same time, to deepen their understanding of algebra.

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Yorkshire & the Humber Events page:

For teachers:
www.furthermaths.org.uk/YH_CPD

For students:
www.furthermaths.org.uk/YH_enrichment