

Centre for Teaching Mathematics News

Issue 5
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Welcome

Welcome to the Spring edition of the CTM News. We publish this newsletter every term and distribute it to schools, colleges and interested people. If you are reading somebody else's copy please contact the Centre secretary to be added to the mailing list. The newsletter will contain information on the staff and activities of the CTM. Each issue will contain a teaching resource which might be a graphic calculator activity, a problem solving activity or a practical mechanics problem. This issue contains the second of a series of games from around the world. Games are a great way of encouraging problem solving skills, logical thinking and visual thinking – all good skills for mathematicians.

The Centre for Teaching Mathematics

The CTM is an inter-faculty group of mathematics educators based at the University of Plymouth within the Mathematics Department and the Education Faculty at Exmouth plus associate members.

The aims of the Centre are:

- Creative Resources and Research
- Training for Teachers
- Mathematics Enrichment for Pupils

Contacting Us

Members of the CTM can be contacted via the Secretary:

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Mathematics Enrichment Programme News

The annual Mathematics Masterclass Series for year 9 students has just finished in Plymouth for students from schools in the Plymouth, South Hams, South East Cornwall and West Devon areas. 80 year 9 students gave up their Saturday mornings for 5 weeks to attend. The classes are open to students who are able, talented and interested in mathematics. The aim of the Mathematics Enrichment Programme at the Centre is to enable interested students of all ages to extend their knowledge of mathematics past that available in the school curriculum. Co-ordinator of the project, Dr Jenny Sharp said "we feel it is important to keep youngsters interested in mathematics while at the same time keeping it fun. This series of Masterclasses enabled us to introduce to the students a wide range of new topics from Mechanics and Coding through to looking at some of the History of Mathematics." This series is the 7th year that the Masterclass programme for year 9 students has been running and the Centre is grateful to the sponsorship from AstraZeneca, who donated £500 towards the cost of this years course. Richard Murray-Smith from Astrazeneca's Brixham Environmental Laboratory said "My son attended the course last year and said it was excellent. The teachers were very inspiring (I went to one of the sessions and saw for myself) and the course has clearly gone from strength to strength over the last few years. It is a credit to the Centre that they manage to get so many school children prepared to give up their Saturday mornings for more maths – that says a lot!" At the final class this series the students were presented with certificates from the Royal Institution of Great Britain who are associated with the Mathematics Masterclass network throughout the UK.

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Mathematics with Education: A degree course for students thinking of Teaching Mathematics

At Plymouth we run an honours degree programme for students who are considering teaching as a career. The course is designed to give students a flavour of school from '*the other side*' i.e. through the eyes of the teaching profession. If by the third year they decide that after all teaching might not be the career to follow then they transfer to the single Mathematics degree programme.

The Mathematics with Education degree provides a solid background in mathematics and statistics together with an introduction to mathematics education. During the first year students follow the same programme as the single subject mathematics students. Then during the second year students follow a double module in which they spend time in a school observing mathematics teachers and working with small groups of pupils. These modules are designed to give our students a real experience of life in school and a chance to confirm that their future career is in mathematics teaching. The third year includes two education modules on how children learn and how teachers teach; further modules in mathematics and statistics and a mathematics education project.

One of our recent graduates, Peter Amblin, reflects on his experiences:

"I'd like to say that I feel that the Maths with Education Degree, especially the 'How Teachers Teach' module and the School Based module has prepared me better than most people for the experience of teaching. I can't deny that there is no fear that parallels that which is forced upon you when you teach a class for the first time, but I must say that due to my experiences in the classroom in my School Based module prior to the PGCE course at Warwick, I feel very confident with standing in front of people and 'teaching'. I was based for this module in one of the local schools in Plymouth and spent a day a week working with small groups of students of different ages to give me experience of the whole side of teaching. Before starting this course I had not had any experience of working with children at all so

it allowed me to discover if I could work with them! I also found the taught courses at Plymouth very interesting and informative, and gave me an edge over my colleagues on the PGCE course when hearing about 'constructivism' or the use of words such as 'didactic' or 'Socratic'. These concepts were not new to me and I was able to contribute to the discussions more freely.

One important part of the course at Plymouth was that it allowed me to develop my reading and writing skills. As a mathematician I am more at home with numbers and my literary skills have not been so strong. However as a teacher I knew I needed to improve these and my final year project combined with dissertations allowed me to develop the skills of reading and writing and I have found this a great benefit both on the PGCE course (some of my colleagues on the course have not written an essay since A level!) and in my teaching practices.

I feel that I have fitted into the teaching role very well as a result of the support and teaching on the Mathematics with Education Degree from University of Plymouth; my first placement report put me in healthy stead for a good job and I am now at Kenilworth school, teaching in my second placement, and enjoying the course. I would recommend this course to any student who wants to study Mathematics at University and who is considering teaching. It is great because after the School Based Module in the second year if you decide teaching is not for you, you can opt out and join the straight maths degree. This way you have not lost anything unlike you would have had you decided to do a BEd or started the PGCE and then found it was not for you."

If any of your students are thinking about teaching mathematics as a career but are not sure then this may be the course for them. For further details about this degree programme please contact John Berry

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AS Mathematics: A Summary of The Results of a Survey of Schools and Colleges

Background

There has been considerable debate about the problems associated with the new Advanced Subsidiary (AS) award introduced in 2000. There have been problems with examination arrangements, but there have also been concerns about the very high failure rate for AS mathematics, and the difficulty that teachers have faced in covering the content required in the time available.

When the results were published in August 2001, the scale of the problems in mathematics entered the public domain. The failure rate for AS mathematics subjects was 28.6%. The failure rate for other AS subjects varied between 4.0% in Classical Subjects to 20.5% in Law. Of the subjects listed in the JCGQ data, 79% had failure rates of less than 16%. The failure rate for mathematics A level over recent years has been around 10%. Clearly the mathematics results stood out as being out of line with other subjects, despite the efforts of the boards to set grade boundaries at levels that would produce acceptable results.

The Centre for Teaching Mathematics was therefore very concerned by the developments at AS and the reactions to them. In order to gain a clearer picture of what was happening in schools and colleges, it was decided to carry out a survey.

Conclusions

The survey had identified a number of issues relating to the implementation of AS Mathematics. These points are now identified and, where possible, suggestions for further consideration are made.

- While the majority of teachers would want to see some changes to the current system, the survey suggests that major changes are not needed, and may not be welcomed. There is a positive view of the modular system and the advantages of its flexibility, so substantial changes to this would probably not be welcomed. The changes that teachers do want to see are related to a reduction in the content of the AS modules.
- There is certainly only limited support for a return to the traditional long examination papers, however there is quite a strong feeling that more accessible examination papers are

badly needed. If the boards were able to produce more accessible papers, on which candidates could score higher marks, the high failure rate that resulted from the summer 2001 examinations would not be repeated and the results for mathematics could be brought into line with other subjects.

- The time available for teaching has been reduced in a number of centres, either due to a reduction in the weekly allocation, or due to the loss of teaching time due to the extra examination periods required by the new structure, or both. This problem could be remedied if the content of the existing modules was pruned. However it is perhaps worth noting again that the level of provision of teaching time per week is not consistent and does vary considerably between some schools.
- There has been a small reduction in the number of students starting an AS mathematics course in 2001 compared to 2000. The size of this reduction at 2.0% is not large and could be attributed to natural variation. However the poor progression rate to A2 of approximately 60% is a cause of concern and ways of improving this progression rate do need to be considered.
- There is a potential benefit that the new structure may encourage more students to study the subject, although there is an attendant danger that some students are not so well prepared when they start an AS in mathematics. There is perhaps a need to consider carefully the progression from GCSE to AS.
- Almost half of the candidates are taking an AS in applied mathematics and so are not covering the content set out in the QCA subject criteria for mathematics, because they are taking AS Applied Mathematics. This problem needs to be considered further. It could be solved by either changing the content of the subject criteria or changing to a four module system.

A copy of the full report is to be published in Teaching Mathematics and its Applications, or can be obtained from Ted Graham.

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Teacher Training News

Following the very successful training courses run last summer we have been busy preparing for Summer 2002. We have a number of courses running this year on a wide variety of different topics. Places are filling up fast so please book early to guarantee a place

The course we are running are:

Teaching and Learning Decision and Discrete Mathematics 1: 1st - 4th July 2002

The course will assume no previous knowledge of the subject area and by the end of the course we would hope that those attending the course will be able to introduce the module to students in their School or College. Decision and Discrete Mathematics is a fairly new area of Applied Mathematics at GCE A- and AS- Mathematics and is growing in popularity particularly among those students who are studying Mathematics to AS-level only.

Teaching and Learning Decision and Discrete Mathematics 2: 3rd – 5th July 2002

The course will assume previous knowledge of the subject area covered by Decision and Discrete 1 and by the end of the course we would hope that those attending the course will be able to introduce the module to students in their School or College.

Teaching and Learning Mathematics with a Graphic Calculator for A level and IB: 24th – 26th June 2002

This course is designed for teachers of A level and IB Mathematics. The course is structured to allow for those teachers who have no experience of a graphic calculator as well as those who have some experience but would like to extend their competence.

Using Graphic Calculators at Key Stage 3 of The National Mathematics Strategy: 3rd – 5th July 2002

This course is designed for teachers of mathematics at Key Stage 3 to support the suggested use of graphic calculators proposed in the Framework for Teaching Mathematics at KS3. The DfEE document emphasises the use of ICT in teaching and learning mathematics and in particular there are specific references to the use of graphic calculators.

Dynamic Geometry for KS3 and KS4: 24th – 26th June 2002

This course is designed for teachers of mathematics at KS3 and 4 to support the

suggested use of dynamic geometry software (such as Cabri Géomètre and Geometry Sketchpad) proposed in the Framework for Teaching Mathematics at Key Stage 3. The DfES document emphasises the use of ICT in teaching and learning mathematics and in particular there are specific references to the use of dynamic geometry software. The course will use Cabri Géomètre and will assume no previous knowledge of this dynamic geometry software; we hope that those attending the course will be able to introduce this software into their teaching.

Supporting IB Mathematics: 27th – 29th June 2002

This course is designed for teachers who are teaching IB mathematics. It will focus on two areas; mathematical modelling and investigations in teaching and learning of Mathematics and the use of the TI-89 (computer algebra system).

Mechanics at A level: 1st – 3rd July 2002

This course is designed for A level mechanics teachers who are either new to teaching the subject or for more experienced teachers who wish to receive some fresh ideas that could be incorporated into their teaching.

Data logging and hand held technology for KS4 Science: 1st – 3rd July 2002

This course is designed for teachers of Science at KS3 and 4. The focus of the course is on the ways in which handheld data logging technology will enable teachers to transform their teaching and the learning in their laboratories. The course will make no assumptions about the data logging technology experience or skills of the participants.

Teaching and Learning Physics at AS and A2 level. 3rd - 5th July 2002

This course is designed for teachers of Physics at AS and A2 level. The focus of the course is on the ways in which handheld and related PC based data logging technology will enable teachers to transform their teaching and the learning in their laboratories.

Full details of these courses can be found at our website

www.tech.plym.ac.uk/maths/CTMHOME/training_courses.htm

or contact Julie Tombs.
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Mu Torere

Mu Torere is a blockade game played by the Ngati Maori people from the east coast of New Zealand's North Island. It is the only board game that the Maori people played before their country was colonised.

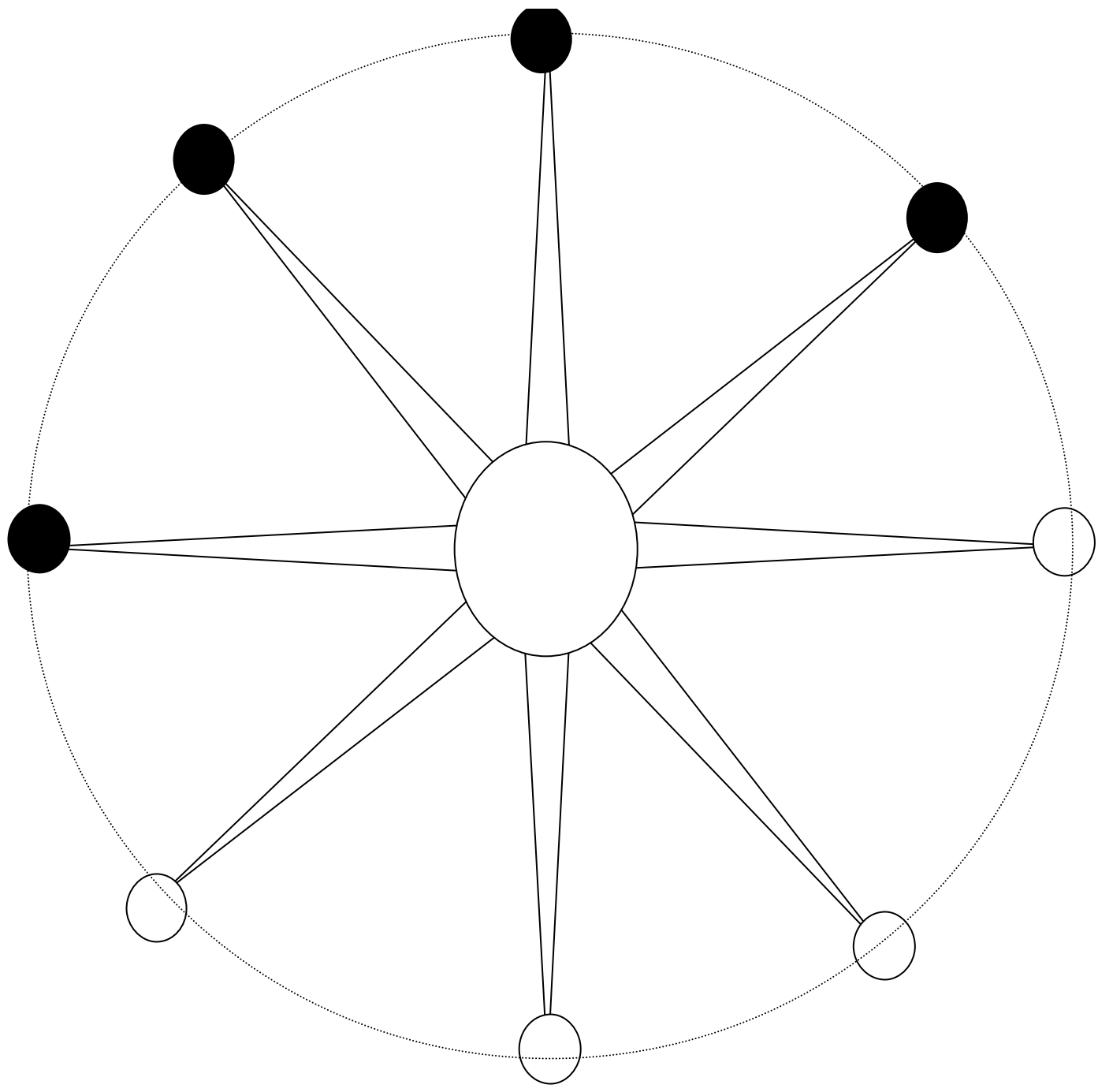
Mu Torere Rules

- Each player always has four counters.
- They are placed on the board at the kawai – the end points of the star.
- The middle – the putahi is left empty at the start.
- Decide which player goes first. A player may move one counter to an empty space.
 - You can only move to an adjacent kawai
 - You can only move to the putahi if your counter is next to one of your opponents.

The winner is the player who blocks all of their opponents pieces preventing them from moving.

Try and think what configuration of counters would prevent your opponent from moving.

Game board overleaf: Enlarge to A3 for ease of playing



I'm in the wrong queue again!

Do you always seem to choose the wrong queue at the supermarket, bank or Post Office? Do people who arrive after you often seem to get served before you?

This may be due to random variations or it may be that you really do always pick the wrong queue. Investigate, by devising a method to simulate, the dynamics of queuing.

Hints and Nudges

- 1 Consider a Post Office where there are two queues for the two servers Sharon and Anne. To conduct a simulation you need to devise a method of assigning customers to each server's queue. Consider ways of doing this.
- 2 The table below can be used to simulate the people arriving at the post office in one minute intervals.

	0	1	2	3	4	5	6	7	8	9
0	3	4	1	5	2	6	1	3	1	4
1	3	3	4	7	0	2	2	2	3	5
2	6	3	4	1	3	2	2	4	9	3
3	2	5	3	5	1	3	5	2	3	3
4	1	6	1	0	1	2	1	7	4	5
5	2	1	2	2	3	2	0	6	4	3
6	0	0	4	8	4	2	3	2	3	1
7	2	2	6	4	3	2	4	4	5	2
8	2	3	1	5	3	4	4	2	3	3
9	3	4	4	5	1	4	5	1	3	1

To extract the number from the table at random obtain two random digits between 0 and 9 from a calculator or tables. Use the first to identify the row and the second the column. For example the random digits 4 and 2 would give 1 customer arriving in that one minute interval.

- 3 Assume that the customers that arrive in the first minute join Sharon's queue and those in the second minute join Anne's queue. Continue to assign customers to each queue in this way as the simulation progresses.
- 4 You will need to consider how to simulate the number of customers served in each minute. The two tables below give the number of customers served per minute for each server. Select numbers at random from each table in the same way as in 2.

Times for Anne

	0	1	2	3	4	5	6	7	8	9
0	2	0	1	3	0	1	2	1	1	0
1	1	0	1	2	0	0	1	0	0	1
2	1	1	1	1	1	3	0	0	3	2
3	2	1	2	0	1	0	0	0	2	3
4	0	1	1	3	1	1	1	2	0	1
5	0	2	0	2	0	2	3	1	1	1
6	0	1	0	1	0	1	1	2	1	1
7	0	1	4	0	1	1	1	2	0	1
8	0	3	1	3	2	2	2	1	0	1
9	0	1	0	1	3	0	0	0	0	1

Times for Sharon

	0	1	2	3	4	5	6	7	8	9
0	1	2	0	3	3	0	4	3	3	2
1	2	2	2	2	3	2	4	0	2	1
2	1	3	3	3	1	2	3	4	1	1
3	0	2	1	2	1	3	5	3	0	0
4	2	2	4	0	1	2	1	1	0	1
5	3	3	5	0	1	1	0	0	4	0
6	2	2	1	3	2	0	4	2	4	1
7	2	6	2	1	1	2	1	3	2	4
8	4	2	1	1	1	0	5	2	1	2
9	3	1	2	1	5	1	3	1	3	2

Select numbers at random from each table in the same way as in 2.

- 5 As the simulation progresses you might record the number of people in each queue, the time that each customer waits and the time the servers have no customers.
- 6 Which queue would you join?

Teacher Notes

Using the tables provided in the *Hints and Nudges* should indicate that Anne's queue will be on average longer than Sharon's queue.

Note that the distributions of all the numbers of customers arriving or being served are Poisson, and the arrivals have mean 3: Sharon's serving has mean 2 and Anne's serving has mean 1.

By looking at people served or arriving in one minute intervals the simulation is relatively simple to conduct. However, it is more usual to consider service times rather than the number served in an interval of time.

If you assume that the service times for individual customers are normally distributed and independent of each other, then so are the total service times for the groups of people in each queue when you arrive. What is more, the difference in total service time for your queue and for another queue will also be normally distributed. If you make some assumptions about the mean and variance of the service times, you can work out the probability of people joining other queues after you have arrived, being served before you.

It would be possible to conduct a theoretical investigation of this problem based on these assumptions.

There is of course the potential to carry out a practical investigation by visiting a supermarket or post office and collecting data.

This investigation comes from Exploring Statistics, one of three books in the Exploring Series (Pure and Mechanics being the others). The books are now out of print but many teachers have requested copies after seeing the students work on some of the problems at our VIth form days. We are in the process of adapting these books for our web pages where they will be available free of charge as PDF files.

www.tech.plym.ac.uk/maths/CTMHOME/resources.htm