

Programme of Exploring Mathematics, 27th June 2007

Abstracts of the plenary talks

1. Professor Fred Piper: Codemakers versus Codebreakers: Who wins?

If two people want to exchange confidential information then one option available to them is to use encryption which their 'enemies' then try to break.

Many commercial systems use encryption algorithms to protect valuable information. These algorithms are frequently international standards which are in the public domain but, so far as we know, have not been broken. In contrast to this, the successful activities of the codebreakers at Bletchley Park in World War 2 are well known.

In this short talk we will look at some of the problems facing the adversaries in this fascinating contest.

2. Dr Yiftach Barnea: Counting Infinity

Many times people talk about infinity as the "biggest number". We will explore the idea of infinity as a number. In particular, we will try to see whether infinite objects may have different sizes.

Abstracts of the small group sessions

1. A special session for teachers:

Jenny Davey (Manager of the Surrey Further Maths Centre at Royal Holloway)

The Recent Growth of Further Mathematics

With the restructuring of the Further Mathematics syllabus in 2004 and the completion of a national Further Mathematics Network, the AS Level course is now open to many more students than previously and numbers have soared. How have universities' views on the subject changed as a result?

2. Dr Christine Davies: Mathematics at University

Are you interested in studying Mathematics at University? This session will deal with the types of course available and the qualifications required, the ways in which university mathematics is different from or similar to that at A level, and the careers available.

3. Dr Christian Elsholtz: Counting Primes

How many primes are there? Well, infinitely many, How can we count them? How many are there in a finite interval from 1 to N ? Are there many primes of the form $p = n^2 + 1$? In this session we will discuss many unsolved problems concerning primes and make some first steps into "counting primes".

4. **Dr Benjamin Klopsch: Mathematics under the Leaning Tower of Pisa**

Imagine you are seated in a small café near the Tower of Pisa in Italy. It is a fine summer day, perfect for mathematical daydreaming. Is it possible to build towers which lean over more seriously? – We will experimentally build such leaning towers and explore the mathematics behind the scene. Not entirely unexpectedly, a cup of strong coffee will save the day.

5. **Dr Keith Mayes: Introduction to Smart Cards**

Smart cards are becoming increasingly important in our day today lives. For example they are found in mobile phones, banking cards, identity cards, electronic-tickets etc. Their general capabilities are quite surprising but a most fundamental feature is tamper-resistant security, which is vital as security systems are often subject to a range of sophisticated attacks. The smart card security defences are provided by a mixture of cryptographic and engineering techniques aimed to stay one step ahead of the hackers.

6. **Dr James McKee: The Mathematics of Doodles**

Learn to play the game of sprouts, plan a walk in a park, and design circuit boards.

7. **Dr Tobias Osborne: Maths of the iPod.**

In this talk I'll describe how the functioning of devices like the ipod relies crucially on the mathematics of waves, termed fourier theory. Additionally, I'll also describe how this theory has played a central role in mathematics, and our everyday life, since its inception in the 1800's.

8. **Dr Maura Paterson:**

From teacups to microphones: an exploration of the cardioid and its uses

Mathematicians have been fascinated by the cardioid curve since it was first studied in the eighteenth century. In this workshop we will explore some methods of constructing cardioids and use basic geometry to examine their properties. We will also see how they are used today to control sound direction in microphones.

9. **Dr Andrew Sheer: Introducing MATHEMATICA**

Mathematica is a sophisticated computer package which we use in teaching, and also for some research. Here you will meet some of the simpler features, including algebra, calculus, and graphical work, and examples such as simulating the National Lottery.