

ROINN NA MATAMAITICE AGUS NA STAITISTICE

DEPARTMENT OF MATHEMATICS & STATISTICS

POSTGRADUATE HANDBOOK

2011/2012

Ollscoil na hÉireann, Má Nuad, Co. Chill Dara, Éire.

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INTRODUCTION TO THE MATHEMATICS & STATISTICS DEPARTMENT, NUI MAYNOOTH

Welcome to the Department of Mathematics & Statistics. We are located on the Top Floor of Logic House at the southern end of the old Campus. We hope you find this handbook of some help to you. If you have any further enquiries, these can be made at the Department Office. This office is located in Room 207 on the Top Floor of Logic House.

OFFICE HOURS:

10.00 a.m. - 11.00 a.m.

12.00 p.m. - 1.00 p.m.

2.00 p.m. - 4.00 p.m.

Telephone: + 353-1-7083914

Fax: + 353-1-7083913

E-mail: admin@maths.nuim.ie.

Website: <http://www.maths.nuim.ie>

The information in this handbook is as accurate as we can make it at the time of going to press, but it may be in error. In the event of difference, the official University rules and procedures take precedence over anything in this handbook, and nothing in this handbook should be understood as official.

TERM DATES: 2011-2012

FIRST SEMESTER

First-Year Registration/Orientation	12 th September 2011	16 th September 2011
First Semester	19 th September 2011	16 th December 2011
Study Week	31 st October 2011	4 th November 2011
Christmas Break	19 th December 2011	30 th December 2011
Study Period	2 nd January 2012	5 th January 2012

SECOND SEMESTER

Second Semester	30 th January 2012	4 th May 2012
Study Week	19 th March 2012	23 rd March 2012
Easter Vacation	9 th April 2012	13 th April 2012
Study Period	7 th May 2012	10 th May 2012

MATHEMATICS & STATISTICS DEPARTMENT STAFF

Professor Stephen Buckley, Head of Department

<http://www.maths.nuim.ie/sbuckleydept/>

Dr Stefan Bechtluft-Sachs, Lecturer

<http://www.maths.nuim.ie/sbechtluftsachs/>

Dr Caroline Brophy, Lecturer

<http://www.maths.nuim.ie/cbrophy/>

Dr Detta Dickinson, Lecturer

<http://www.maths.nuim.ie/ddickinson/>

Dr Katarina Domijan, Lecturer

<http://www.maths.nuim.ie/kdomijan/>

Dr Catherine Hurley, Senior Lecturer

<http://www.maths.nuim.ie/churley/>

Professor George Huxley

Adjunct Professor

Department of Mathematics & Department of Ancient Classics

Dr Séamus Kelly, Lecturer

<http://www.maths.nuim.ie/skelly/>

Dr Ciarán Mac an Bhaird, Lecturer

Mathematics Support Centre Manager

<http://www.maths.nuim.ie/canbard/>

Dr Pat McCarthy, Lecturer

<http://www.maths.nuim.ie/pmccarthy/>

Dr John Murray, Senior Lecturer

<http://www.maths.nuim.ie/jmurray/>

Dr Fiacre Ó Cairbre, Senior Lecturer

<http://www.maths.nuim.ie/focairbre/>

Professor Anthony G. O'Farrell

<http://www.maths.nuim.ie/aofarrell/>

Dr Ann O'Shea, Lecturer

<http://www.maths.nuim.ie/aoshea/>

Dr Lars Pforte, Lecturer

<http://www.maths.nuim.ie/lpforte/>

Dr David Redmond, Senior Lecturer
University Registrar, Humanity House
(Tel: 01 – 708 3579)

<http://registrar.nuim.ie/>

Dr Anthony Small, Senior Lecturer

<http://www.maths.nuim.ie/asmall/>

Dr David Wraith, Senior Lecturer

<http://www.maths.nuim.ie/dwraith>

POSTDOCTORAL RESEARCHERS

Dr Natalia Budarina

<http://www.maths.nuim.ie/nbudarina/>

SUPPORT STAFF

Ms. Janice Love, Senior Technical Officer

<http://www.maths.nuim.ie/staff/>

Ms. Gráinne O'Rourke, Administrator

(Tel: 01 – 7083914/3651)

<http://www.maths.nuim.ie/staff/>

Mr. Anthony Waldron, Technical Officer

<http://www.maths.nuim.ie/staff/>

PART-TIME STAFF 2011/12

Please refer to the Mathematics Department website:

<http://www.maths.nuim.ie/staff>

POSTGRADUATE CO-ORDINATOR 2011 / -

Dr Stefan Bechtluft-Sachs, Lecturer

<http://www.maths.nuim.ie/sbechtluftsachs/>

RESEARCH INTERESTS OF STAFF

Dr. Stefan Bechtluft-Sachs

Stefan Bechtluft-Sachs' research deals with the relation of (algebraic) topology on one side and differential geometry and (global) analysis on the other. Specifically Stefan works on the role variational calculus, in particular natural functionals, plays in homotopy theory. Moreover he is interested in topological obstructions to certain curvature properties of manifolds.

Dr. Caroline Brophy

Caroline Brophy's research interests are in the development and application of statistical modelling techniques to non-standard situations in Ecology and Environmental Science. The Statistical topics she is particularly interested in are mixture models, functional relationship models, multinomial models, mixed models, methods for modelling data with large numbers of missing or zero values, methods for predicting the mean response without bias from non-linear models and bootstrapping methods for assessing predictions from non-linear models. The Ecological and Environmental topics she is currently working on are climate change, biodiversity in grassland systems, competition in a range of ecological systems, and genotypic variability in allergenic plant species.

Professor Stephen Buckley

Stephen Buckley's research interests lie in geometric analysis in the settings of Euclidean space, metric spaces, or metric measure spaces. He is particularly interested in various weak notions of negative or nonpositive curvature such as Gromov hyperbolicity, $CAT(0)$, Busemann convexity, and the Ptolemaic inequality.

He is also interested in quasiconformal mappings, potential theory, metric measure spaces, Gromov hyperbolicity, geometric function theory, and other fields in geometric and harmonic analysis. In particular, he has studied various types of Poincaré and Trudinger inequalities, over Euclidean and non-Euclidean spaces, especially the connection between such analytic inequalities and geometry.

Dr. Natalia Budarina

Natalia Budarina is interested in the metric theory of Diophantine approximation, Khintchine-Type Theorems and simultaneous Diophantine approximation.

Recently, she became interested in Diophantine approximation. Natalia considers the classical problem of arithmetic theory of the quadratic forms on integer representations by another form of lower dimension. The increase of the dimension of the problem allows us to apply the deformation method of the quadratic systems. Using local methods (Venkov, Mordell, Witt, Hasse, Kneser, Kitaoka, Watson, Niemeier, Conway, Sloane, Zhuravlev) Natalia considers special kinds of specialization of quadratic systems, when their global and local arithmetic properties are transformed by rational methods. The deformation method of quadratic systems through non-homogeneous specialization allows us to connect the space of quadratic forms with the important theoretic-numerical problem: the number of solutions for equations of the highest degrees and prime twins.

Dr. Detta Dickinson

Detta Dickinson's research interests lie in the areas of measure theory and metric Diophantine approximation. In particular, Diophantine approximation on manifolds.

Classically, Diophantine approximation is the study of how well real numbers can be approximated by rationals. This can be extended to higher dimensions by asking how well real points in n -dimensional Euclidean space can be approximated by rational points or by rational hyperplanes. Results in this area are very delicate as shown in Khintchine's theorem, where the set of well approximable points has either zero or full measure depending on the convergence or divergence of a certain volume sum. This leads to further questions - those of Hausdorff dimension in the case of measure zero and those of asymptotic number of solutions in the case of full measure.

Both of the above questions become more difficult when the set under investigation is restricted to a manifold embedded in Euclidean space and this is Detta's current area of interest.

Dr. Katarina Domijan

Katarina Domijan's research interests lie in applying Bayesian methods of statistical inference to analyze data of complex structure that arise in a variety of applications. In particular, I am interested in classification problems in data with large feature spaces. One of the most important aspects of modelling high-dimensional data is feature selection and I am interested in developing novel methods for this challenging problem.

Dr. Catherine Hurley

Catherine Hurley's research interests are in statistical computing, graphics and data analysis. At present the focus of these interests is the design of software for interactive statistical graphics. This work has resulted in new software for statistical graphics, which is part of the QUAIL (for Quantitative Analysis In Lisp) system, available from the University of Waterloo Statistical Computing Laboratory.

Dr. Ciarán Mac an Bhaird

Ciarán Mac an Bhaird's current areas of research focus on Mathematics Education and Algebraic Number Theory. In Maths Education he is working on the benefits of introducing new methods of teaching Maths to students. He is particularly interested in using podcasts, screencasts and touchscreen technology. He is also developing resources to help introduce the history and background of mathematical topics to students at all levels. He is also working on investigations into the levels of student engagement with extra Mathematics Support initiatives. In Algebraic Number Theory he is interested in Gauss Sums and Cyclotomic Numbers. He is currently working with the computer package Singular in order to investigate these topics further.

Dr. Pat McCarthy

Pat McCarthy is interested in Classical Function Spaces and the inequalities which arise in their study. Examples include H^p , L^p and Lipschitz spaces.

He has worked on convergence problems for Fourier series and extremal properties of certain orthogonal polynomials. Currently he is examining generalisations of Carleson Interpolation Sequences.

Another interest is Number Theory, cryptography, and the implementation of cryptographic routines and cipher attacks on microprocessors.

Dr. John Murray

John Murray works on the modular representation theory of groups. Representation theory is the study of concrete realisations of the axiomatic systems of abstract algebra. It originated in the study of permutation groups and algebras of matrices. The representation theory of finite groups was developed by G. Frobenius in the last decade of the nineteenth century. Major applications were quickly found by W. Burnside and I. Schur. R. Brauer began his investigations into the modular representations of finite groups in 1939. His work was the genesis of the programme to classify the finite simple groups, which reached fruition in the early 1980's. Other landmarks in the subject include the 1956 paper of J. Green on the general linear group, the work of P. Deligne and G. Lusztig in the 1970's on algebraic groups, and the (still open) conjectures of J. Alperin, G. Robinson and E. Dade from the late 1980's on the p-defects of characters.

Dr. Murray is fascinated by all aspects of this rapidly changing subject. He is particularly interested in the structure of the centres of modular group algebras, the block theory of finite groups, properties of involutions, and generally in the connections between ring theoretic and group theoretic invariants of algebras. He has written a number of papers on these topics. John has developed and implemented algorithms for the computer package GAP to facilitate his investigation into the structure of finite algebras. At the moment he is working on the proof of a result that concerns the involution classes of symmetric groups, using the ring of symmetric functions and the class algebra of I. MacDonal.

Dr. Fiacre Ó Cairbre

Fiacre Ó Cairbre's research interests are currently in the two areas of stability theory and mathematics education. He is working on the stability of certain types of switching systems in control theory. He is also working on resource materials for second level mathematics teachers.

Professor Anthony G. O'Farrell

Pairs of noncommuting involutive maps play central roles in a wide range of superficially-unconnected applications. An involution is a map which equals its own inverse. The theory of single involutions is not simple, but is well-developed. In abstract algebra, group theorists have studied involutions since the beginning, and they play a basic structural role. Groups generated by exactly two involutions are called dihedral (because they include the classical symmetry groups of the regular polygons). They are very much more special than the groups generated by three involutions. At the same time, the group generated by two involutive maps displays rather complex and varied behaviour, and there is a rich field of possibilities. Examples occur naturally in problems as diverse as classical Hamiltonian dynamical systems (such as the n-body problem), complex dynamics in one and several variables, the theory of biholomorphic classification of surfaces, the conformal mapping of quartic lemniscates, multivariate uniform approximation

theory, complex polynomial approximation, one-dimensional real dynamical systems (with applications in electronics, laser physics, population biology, etc.).

It is also interesting to study reversibility in general, even when the reversing map is not involutive. Applications of such reversible systems occur in the study of the so-called reciprocal geodesics in hyperbolic geometry, and in the (related) study of the representation of integers by binary quadratic forms. They also occur in the group of biholomorphic germs, and in problems about the classification of 3-manifold foliations.

For some years now, Professor O'Farrell and others have been studying reversibility systematically, with a view to classifying the possibilities and elucidating the general structure. A good deal of work has been completed on reversibility in various groups of maps. The difficult thing in each case is to understand the interaction between the algebraic reversibility condition and the topological (or differential, or analytic, or formal) properties of the maps. There are many groups that are, as yet, unexplored, and some of these provide reasonable, interesting and challenging projects. A monograph, written jointly with Ian Short, has been drafted, setting out the state of current knowledge about reversible discrete systems, and this should prove a useful guide to new entrants to the field.

Professor O'Farrell remains interested in other areas, notably approximation problems involving functions of one or several complex variables. More specifically, the functions of interest are analytic (or holomorphic) on some open set, and one is interested in approximating them by analytic polynomials or rational functions, or even just by functions analytic on a slightly larger open set. Such problems are connected with geometric, measure-theoretic, potential-theoretic and functional-analytic questions, and especially with capacities, plurisubharmonic functions, polynomial, rational and complex analysis. It is sometimes advantageous to exploit additional algebraic structure, such as algebra or lattice structures, present in the situation.

Dr. Ann O'Shea

Ann O'Shea is interested in Mathematics Education. Current research projects include: investigating concept formation; investigating the effects of beliefs and attitudes on learning; measuring the effectiveness of mathematics support. She has also worked in the area of Value Distribution Theory in Several Complex Variables.

Dr. David Redmond

David Redmond's area of specialization is Group Theory and Permutation Groups. He has been working with Professor Quinn (Maynooth) and Dr. P.W. Fowler (Exeter) on the application of group theory in Chemistry and in particular on the recent developments in the chemistry and geometry of Fullerenes.

Dr. Anthony Small

Anthony Small is working on problems in algebraic/differential geometry, in particular the construction and study of differential geometric objects of variational origin, via 'transforms' that convert the data into more tractable algebro-geometric objects, e.g. minimal surfaces (soap films), constant mean curvature surfaces (soap bubbles), monopoles.

Dr. David Wraith

David Wraith's research interests encompass Differential Geometry and Algebraic Topology, and focus primarily on the topological implications of positive curvature. Most of his work to date explores the effects of surgery on Ricci positive manifolds.

INTRODUCTION TO POSTGRADUATE COURSES

The Mathematics & Statistics Department offers postgraduate students the opportunity to study Mathematics or Statistics for the degrees of PhD, MSc, MA, or for a Higher Diploma in Mathematical Studies, Mathematics and Statistics.

Please note that all postgraduate Mathematics and Statistics courses can be taken on a part-time basis over two or more years. Students who study on a part-time basis attend the regular daytime classes. The Department does not offer any classes during the evening or at weekends.

Information on Fees can be found on the University website at:

<http://fees.nuim.ie/feesschedule.shtml>

HIGHER DIPLOMA IN MATHEMATICAL STUDIES

<http://www.maths.nuim.ie/pgprogrammes#HDMS>

HIGHER DIPLOMA IN MATHEMATICS

<http://www.maths.nuim.ie/pgprogrammes#HDM1>

HIGHER DIPLOMA IN STATISTICS

<http://www.maths.nuim.ie/pgprogrammes#HDS>

MLitt in MATHEMATICS BY RESEARCH

<http://www2.maths.nuim.ie/pgprogrammes#MLitt-R>

MSc in MATHEMATICS OR STATISTICS BY RESEARCH

<http://www2.maths.nuim.ie/pgprogrammes#MSc-R>

MSc in MATHEMATICS BY EXAMINATION

<http://www2.maths.nuim.ie/pgprogrammes#MSc-E>

MA IN MATHEMATICS BY EXAMINATION

<http://www2.maths.nuim.ie/pgprogrammes#MA-E>

MASTER IN MATHEMATICS FOR EDUCATION

<http://www2.maths.nuim.ie/mscmathedmain>

DOCTOR OF PHILOSOPHY IN MATHEMATICS OR STATISTICS

<http://www2.maths.nuim.ie/pgprogrammes#PhD>

SOCRATES Program

<http://www2.maths.nuim.ie/pgprogrammes#SOC>

SCHOLASTIC FUNDING

There are opportunities for talented postgraduate students to get funding at NUI Maynooth, in either taught or research based courses. Depending on the nature of the award, this can range from funding to cover fees, up to a full scholarship with not only fees, but a living allowance and provision for expenses also.

Competition for both NUI Maynooth funding and funding from other agencies is very high.

Further information can be found on the NUIM website at:

<http://graduatestudies.nuim.ie/feesfundingfinance/funding>

RESEARCH STUDENT SUPERVISORY POLICIES

The PhD Research Student Supervisory Policy has been reviewed for 2008, and following ratification from Academic Council, was published for use throughout the University in October 2008.

The University has produced the PhD Research Student Supervisory Policy both PDF and as a web page.

<http://graduatestudies.nuim.ie/policies/universypolicies/phdresearchstudentsupervisorypolicy>

Students doing research degrees should also read the Mathematics Department Research Student Policy Document:

<http://www.maths.nuim.ie/documents/uploads/deptpolicyresearchstudents1011.pdf>

Structured Research students must take a certain number of taught modules, as explained in the above policy document. Other research students can also avail of these modules. The most relevant modules are the 800 level modules on the following webpage, although 500-level and other modules can also be taken with the permission of the Head of Department:

<http://www.maths.nuim.ie/pgmoduledescriptors>

HOW TO APPLY FOR A POSTGRADUATE COURSE AT NUI MAYNOOTH

TAUGHT POSTGRADUATE COURSES:

Before you submit an application, please discuss your choice of course with Dr. Stefan Bechtluft-Sachs (Postgraduate Coordinator).

Stefan.bechtluft-sachs@nuim.ie
Tel: +353 1 708 4621

RESEARCH DEGREE:

Before submitting any application for a Research degree, please ensure you have the prior agreement of a research supervisor.

If you have satisfied the above criteria, you may proceed and submit your application to the:

POSTGRADUATE APPLICATIONS CENTRE

www.pac.ie/nuim