Mathematisch Instituut, Universiteit Leiden

Annual Report 2010

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Annual Report 2010

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Cluster 1. Number Theory, Algebra and Geometry

Research Programme 1.1: Number Theory and Algebra
Programme leader: H.W. Lenstra

Description of the project

The main focus of the research programme is number theory. Number theory studies the properties of integers, with a historically strong emphasis on the study of diophantine equations, that is, systems of equations that are to be solved in integers. The methods of number theory are taken from several other branches of mathematics. Traditionally, these include algebra and analysis, and in recent times algebraic geometry has become increasingly important. Another recent development is the discovery that number theory has significant implications in more applied areas, such as cryptography, theoretical computer science, the theory of dynamical systems, and numerical mathematics. This discovery led to the rise of algorithmic and computational number theory, which occupies itself with the design, analysis, and efficient implementation of arithmetical algorithms. The overall result has been a unification rather than a diversification of number theory. For example, the applications in cryptography depend heavily on algebraic geometry, and algebraic number theory, which used to stand on itself, is now pervading virtually all of number theory. Themes of the programme reflect the research areas mentioned. They include finding points on algebraic curves, applications of group theory and algebraic number theory, the theory of finite fields, diophantine approximation, words and sequences, discrete tomography, primality tests and factorization methods, and the development of efficient computer algorithms.

The algebra portion of the programme is strongly oriented towards the applications of algebra in number theory and arithmetic geometry and towards algorithmic aspects. Themes include Galois theory and various aspects of group theory and ring theory.

The research programme also includes cryptology and the history of mathematics. Main themes in cryptology are the applications of number theory and algebra to the design of cryptographic schemes, and foundational issues are considered as well. In the history of mathematics, the emphasis is on the edition and translation of early Islamic mathematical and astronomical texts.

Research results in 2010

Evertse has finished a preprint with R. Ferretti (Lugano) on the Quantitative Subspace Theorem. This is an important tool for applications to Diophantine equations and inequalities. This preprint has been submitted for publication.

Together with A. Bérczes and K. Győry (Debrecen) Evertse has finished a preprint on multiply monogenic orders (these are orders O in number fields such that $Z[a]=O$ is satisfied by "different" elements a from O). This preprint has been submitted for publication.

In 1960, Lang proved that unit equations in two unknowns, where the units are from a finitely generated domain of characteristic 0, have only finitely many solutions. His proof was ineffective. In 1979, Győry gave an effective proof of this result in case that the domain is contained in an algebraic number field. Together with Győry Evertse gave an effective proof of Lang's result in full generality. This is work in progress.

Together with Győry Evertse is writing a book on unit equations and discriminant equations. This is also work in progress.

Lenstra worked, in cooperation with several students, postdocs, visitors, and colleagues, on a variety of topics, including zeta functions for finite groups, iterated semidirect products, a special class of supersolvable groups, field topologies, number fields with the same L-functions, anisotropic modules, finding integral closures, elements of provably high order in finite fields, radical Galois groups, layered lattices, Mersenne primes, norm residue symbols, irreducible cubics modulo five, the Lenstra calculator, false complex multiplication, and Greek arithmetical poetry.

Van Luijk co-organized, together with Lenstra, Salgado, and Chinburg, a conference on the arithmetic of surfaces. He gave talks at various conferences and seminars, had several papers accepted, and started some more collaborations.

B. de Smit continued joint work with C. Sutton (Dartmouth) and R. Gornet (Arlington, Texas) on the covering spectrum of isospectral Riemannian manifolds. He also initiated a new collaboration with T. Chinburg (Philadelphia) and F. Bleher (Iowa City) on the inverse problem for deformation rings of linear representations. Further progress on this subject was obained jointly with ALGANT master student R. Rainone.

After the lecture of G. Cornelissen (Utrecht) at the final summer conference of the European Network GTEM in Barcelona, B. de Smit obtained initial results on the degree to which a number field can be characterized by its abelian L-functions, which have been improved further in 2011.

The collaborative computational project ABC@Home (abcathome.com) continued to run in 2010 under supervision of B. de Smit. It was improved further, and data collected from many thousands of computers will be ready for publication in 2011.

Marco Streng finished his PhD-thesis on the complex multiplication for abelian surfaces. Its main result is an improved algorithm for the computation of Igusa class polynomials, together with a complete run time estimate. In addition, it provides CM-constructions for pairing-friendly abelian varieties (with Freeman and Stevenhagen) and abelian surfaces of p-rank 1 (with Hitt, McGuire and Naehrig).

Stevenhagen worked with Moree (Bonn) on variants of Artin's primitive root conjecture, and with Howe (San Diego) on genus-2 curves with split Jacobians.

Research Programme 1.2: Arithmetic Geometry
Programme leader: S.J. Edixhoven

Description of the project

Geometers study geometric properties of sets of solutions of systems of equations. According to the possible kinds of equations (continuous, differentiable, analytic, polynomial), and of the structures that one studies, one distinguishes kinds of geometry (topology, differential topology and differential geometry, analytic geometry, algebraic geometry, arithmetic geometry).

In algebraic geometry the equations are given by polynomials. Classically, the coefficients and solutions were complex numbers. Number theorists consider integer or rational coefficients and solutions. The goal of arithmetic geometry is to understand the relations between algebraic geometry and number theory.

Three important notions in arithmetic geometry are “algebraic variety” (abstraction of system of polynomial equations), “zeta function” and “cohomology”. Zeta functions associated to algebraic varieties are generating functions defined using the numbers of solutions in finite fields. Cohomology associates vector spaces equipped with certain structures to algebraic varieties. One important aim of arithmetic geometry is to understand the relations between the values of zeta functions at integers and properties of the set of rational solutions. Cohomology plays an important role here. Cohomology also provides representations of Galois groups, which is essential for Langlands's program (relations between such representations and “automorphic” representations of matrix groups). The most striking results obtained in this field are the proof of Weil's conjectures (Dwork, Grothendieck, Deligne), Faltings's proof of Mordell's conjecture, Fontaine's theory (comparison between certain cohomologies), Wiles's proof of Fermat's Last Theorem, and Lafforgue's result on Langlands's conjectures.

Apart from its numerous applications within mathematics, algebraic geometry over finite fields provides error correcting codes and crypto systems, both used in everyday life.

Research results in 2010

P. Bruin completed the work on his PhD thesis “Modular curves, Arakelov theory, algorithmic applications”. The main result of his thesis is the existence, under minor technical assumptions, of a probabilistic algorithm that computes the Galois representation associated to a given Hecke eigenform over a finite field that is polynomial in the weight and the level of the form and the cardinality of the finite field. This result generalizes an earlier result due to Couveignes, Edixhoven et al.

As an application of his main result Bruin proved the following theorem, of considerable interest in number theory: assume the generalized Riemann hypothesis for number fields. Then there is a probabilistic algorithm that, given an even positive integer k and a positive integer m in factored form, computes the number of times m can be written as a sum of k squares, in time polynomial in k and the number of digits of m.

The last application essentially boils down to the assertion that the coefficients in even powers of a standard theta series can be computed quickly. It was shown by I. Varma in her master thesis under supervision of Edixhoven and Bruin that for even powers larger than 10, in some precise sense no “closed formulas” exist for these coefficients. However, Bruin's result shows that nevertheless one can compute these coefficients as fast as if such closed formulas would have existed.

L. Taelman continued his research on special values of Goss L-functions associated to Drinfeld modules and t-motives. A breakthrough was obtained with a theorem that includes characteristic-p-valued analogues of both the class number formula and the Birch and Swinnerton-Dyer conjecture. This result (arxiv:1004.4304) will appear in the Annals of Mathematics in 2011.
Related to this project, he also obtained some finiteness results and comparison isomorphisms for the cohomology of the Carlitz module and related objects.

A. Stolk completed his PhD thesis 'Reconstructing integer-valued functions from line sums'. His thesis gives a systematic account of algebraic and algorithmic aspects of discrete tomography, especially grid reconstruction. Some explicit calculations of dependencies for a 2-regular sequence of primitive directions in Z^2 are given and periodic grids have been considered in detail.

R. de Jong extended his 2009 results on canonical heights on Galois covers of the projective line. Also he found the relation between invariants of Riemann surfaces considered in a recent Inventiones article of S. Zhang, and invariants of Riemann surfaces considered around ten years ago by R. Hain and D. Reed. As a consequence he could determine the asymptotic behavior of Zhang's invariants, and calculate them explicitly for hyperelliptic curves. He started research on the non-archimedean side of this matter.

Cluster 2. Analysis and Stochastics

Research Programme 2.1: Analysis and Dynamical Systems
Programme leader: A. Doelman

Description of the project
This program focuses on asymptotic operator-theoretical methods to analyze problems arising from concrete classes of integral, differential and difference equations. Both linear and non-linear equations are studied, and the problems may have a finite-dimensional or infinite-dimensional character. Typical for this program is a strong interaction with dynamical systems, functional analysis, numerical analysis, partial differential equations, probability theory and complex function theory.
There is a special focus on the analysis of infinite dimensional dynamical systems and applications. Determining the long-term behavior of dynamical systems can be a time consuming and difficult task. It is often essential to combine perturbation and numerical methods with methods from dynamical systems theory. Rather than considering the equations for fixed values of the physical parameters, we often study solutions as a function of the physical parameters. Specific examples that are investigated include singularly perturbed equations, dynamical systems with time delays in the feedback loop, differential equations modeled on a lattice, and various model systems that govern processes in earth sciences, life sciences and engineering.
The current research interests of the group include: Algebras associated with dynamical systems, pattern formation, differential-difference equations of mixed type, localized structures in reaction-diffusion equations, invariant measures for stochastic delay equations, Ginzburg-Landau equations, etc.

Algebras associated with dynamical systems
When a group G acts on a Banach algebra A there are several algebras of crossed product type naturally associated with these data. It is the aim of this project to understand the relationship between the associated algebra and the initial dynamical system. Well rooted in C*-theory is the case where A is the algebra of continuous functions on a compact Hausdorff space X and the group G is the integers, in which case one wants to understand the structure of the associated algebra in terms of the dynamical system on X, but the even more naturally associated involutive Banach algebra of crossed product type (an L^1-algebra with twisted convolution) is also under investigation.
Another main line of research consists of constructing the appropriate Banach algebra crossed product for a given set of covariant representations of a Banach algebra dynamical system. This is a natural generalization of C*-crossed products and is analogously expected to be the main tool when studying group representations in Banach spaces and induction procedures in these spaces.

Positive representations
There is an abundance of examples, within and outside mathematics, of groups acting as positive operators in Riesz spaces and Banach lattices. Quite in contrast to the analogous case of unitary representations, such positive representations have not yet been investigated systematically. It is the aim of this project to initiate this theory. Current focuses are on finite and compact groups, and on the construction of a Banach lattice algebra of crossed product type analogous to the group C*-algebra in the unitary case. For the latter, there is a close connection with the previous project.

Local spectral theory
Local spectral theory determines, amongst others, local reasons for complex numbers to be in the global spectrum of an operator. It is the aim of this project to determine the local spectrum of suitable unbounded operators and to establish local spectral radius formulas for such operators.

Pattern Formation
Pattern formation, or: the dynamics of spatial structures described by high dimensional dynamical systems (mostly partial differential equations) is a central theme within the research of Doelman. His research builds on two foundations: fundamental analysis of "simple" patterns such as localized or spatially periodic patterns and applied analysis of explicit models that generate patterns. Of course there is a strong interaction between these two aspect of Doelman's research. Topics within the former aspect include Evans function methods, the dynamics of modulated waves, the interactions between localized structures.
The applications range from phytoplankton dynamics and internal (oceanic) waves to Josephson junctions and fuel cells. The models often have a reaction-diffusion structure, but can also be on sine-Gordon, nonlinear Schrodinger or Cahn-Hilliard type

Singularity formation in natural systems.
Singularities arise when nonlinear effects dominate the dispersive ones, up to the formation of the singularity. Singularity formation, also called blowup, has received a considerable amount of attention in problems ranging from nonlinear optics, plasma physics and combustion to hydrodynamics,and from stellar dynamics to chemotaxis in bacteria. In work of Rottschäfer, the formation of singularities is studied in projects that are motivated by these concrete applications. The equations that are used to model the applications can be divided into two classes: amplitude equations, such as the Korteweg-de Vries equation, and systems of reaction-diffusion equations. In the study of blowup solutions for these equations, combination of numerical, asymptotical and geometrical methods is used.
This research is part of the VIDI project of Rottschäfer.

Applications to Life Sciences
This research project concerns the modeling, analysis and simulation of long-term behaviour of discrete and continuous dynamical systems that occur in Life Sciences, in particular in chemotaxis of unicellular organisms, cell signaling and plant (secondary) metabolism. From a mathematical modeling perspective, these three biological topics result in the analysis and simulation of measure-valued structured population models with 'internal' dynamics for individuals described by systems of nonlinear ordinary differential equations. That is, a prototypical example of a system of mixed type.
The mathematical research focuses on: (1) the long-term behaviour of systems of measure-valued evolutionary equations of mixed type using a functional analytic (semigroup) approach; (2) application of the fundamental results of part (1) to experimental systems, in particular the gradient detection system in Dictyostelium chemotaxis, auxine transport in Arabidopsis and secondary metabolite production in cell suspension cultures of Catharanthus roseus (among others in collaboration with the groups of, respectively, prof.dr. T. Schmidt, prof.dr. B. van Duijn and prof.dr. R. Verpoorte); and (3) data oriented system's analysis: e.g. system properties, like attractors, are numerically approximated based on experimental data, and parameter estimation.

Applications to Earth Sciences
Development of a computational method for the control of dike heights (research carried out at both the Mathematical Institute and CWI).

The Dutch government institute Deltares (the former Rijkswaterstaat) continuously inspects the degree of protection against flooding of large parts of the Netherlands, offered by primary dikes and by the dunes.
Following the 1953 floodings, van Dantzig (Mathematisch Centrum, the current CWI) developed a mathematical model with which the optimal height of a dike can be computed. The model also allows to compute when and how much, optimally, a dike has to be increased. The model concerns a control problem in which a minimum is found in the cost for dike increase plus the expected cost due to flooding. The model has been elaborated in software which is being used on a routine basis for many years already. However, the model no longer satisfies tomorrow's safety requirements. It is unsuited for quickly incorporating new insights, e.g., new flooding chances (following from more accurate predictions of climate change) and new rates of economical growth (or shrinkage); the model lacks dynamics. Further, it does not consider uncertainty in the underlying climatological and economical models; it also lacks stochastics. Both shortcomings are remedied in the current research project.

Environmental Sciences
Two research projects within the group are in the field of environmental sciences and appear at the overlap between earth and life sciences. The first one is a collaboration between Doelman, de Swart (IMAU, Utrecht), Zagaris (UT) and their mutual PhD student Zijlstra (CWI). In the project the dynamics of phytoplankton is studied. Central topic of investigation is the formation and subsequent bifurcations of “deep chlorophyll maxima”. In another project, Doelman studies the dynamics of vegetation patterns and their crucial role in the process of desertification. This is a joint project with Rademacher (CWI), Rietkerk (Environmental Sciences, Utrecht) and van der Stelt (PhD student, CWI/UvA).

Applications to Energy Engineering
Development of a computational tool for the simulation of wind-farm aerodynamics (research carried out at both the Mathematical Institute, CWI and the Energy Research Center of the Netherlands).
The Dutch government plans that a significant portion of the Dutch future energy need is to be produced by wind farms at the North Sea. A wind farm is a large set of wind turbines positioned in some matrix form. Various research questions still exist with respect to wind farms; economical, ecological and technological. A major technological question is how to position and design the separate wind turbines, such that the energy production of the wind farm as a whole is maximal.
Investigation, with analytical and computational tools, of instabilities in tokamak plasmas, in which fusion of deuterium and tritium nuclei occurs. This research is done in cooperation with the FOM Institute for Plasma Physics, and is directed towards the ITER tokamak, which is currently under construction in Cadarache, France. The specific instabilities that are investigated are so-called edge localized modes, instabilities at the outer edge of the tokamak plasma, that show similarity with solar flares.

Research results in 2010
In 2010 B. Koren worked on the following projects:

Development of an immersed boundary method for convection problems, with PhD-student Y. Hassen (funded by Delft Centre for Computational Science and Engineering).

Development of a computational method for the simulation of wind-farm aerodynamics, with PhD-student B. Sanderse (funded by Energy Research Centre of the Netherlands).

Investigation of Edge Localized Modes in tokamak plasmas, by further development and application of computational tools, with PhD-student W. Haverkort (funded by FOM Institute for Plasma Physics Rijnhuizen)

MHD modelling of edge localized modes, control and mitigation, with PhD-student B. van Es (funded by FOM Institute for Plasma Physics Rijnhuizen).

Stojkovic has generalized the theory of maximal monotone operators and the according Cauchy problems from Hilbert spaces to the Wasserstein-2 space over the finite dimensional Euclidean space. This theory extends results for gradient flows on Wasserstein spaces. Further, Stojkovic has shown that the flow of solutions of the nonsymmetric Fokker-Planck equation induces a contraction semigroup on the Wasserstein-2 space with regularity properties of the paths similar to the symmetric case.

Kalauch (Dresden) and van Gaans have constructed the tensor product of Archimedean partially ordered vector spaces by means of Riesz completions.

Rusinek (Warsaw) and van Gaans have proved new growth estimates for the shift semigroup on weighted Sobolev spaces, which yield sharper conditions for existence of invariant measures for a term structure model of Musiela.

Alkurdi, Hille, and van Gaans have introduced a metric on a space consisting of functions defined on different intervals analogous to the Skorohod metric.

M. de Jeu continued his collaboration with J. Tomiyama (Tokyo) and determined the pure state space of the canonical maximal abelian subalgebra of the involutive Banach algebras associated with a dynamical system. On basis of this description the projection issue for these masa's was completely clarified.

M. de Jeu and M. Wortel, in joint work with S. Dirksen (Delft), constructed a crossed product Banach algebra associated with a Banach algebra dynamical system, which has the desired bijection between its representations and the covariant representations of the original Banach algebra dynamical system.
These crossed product Banach algebras were characterised by a universal property by M. Messerschmidt.

M. de Jeu and M. Wortel made considerable progress in the study of positive representations of finite groups. Order irreducible representatons were shown to be finite-dimensional (a rather non-trivial result in this case) and these representations were then classified. Induction and Frobenius reciprocity were also considered.

M. de Jeu and M. Messerschmidt established a Jordan-Holder theorem for actions of groups and algebras in Riesz spaces.

M. de Jeu and N. Andersen (Sonderborg, Denmark) determined the local spectrum for a number of well-known differential operators, and showed that a local spectral radius formula holds for these operators.

Singular multi-bump solutions of the Ginzburg-Landau equation (GL) have been studied by Rottschäfer.

Via a geometric construction, two types of multi-bump blowup solutions of the Ginzburg-Landau equation were shown to exist previously. At x = 0, one type of the solutions is exponentially small, the other type is algebraically small. Asymptotic methods were used to study the solutions which are algebraically small at x =0 , the other type has already been studied. The key ingredient of the analysis is that the maximum of the solutions, the bump, must be placed at an essentially different location than for the other type of solutions.

Research Programme 2.2: Probability Theory
Programme leader: W.Th.F. den Hollander

Description of the project

Interacting stochastic systems consist of a large number of interacting random components. These components interact with each other and with their environment. Even when the interaction is local, such systems typically exhibit a complex global behavior, with a long-range dependence resulting in anomalous fluctuations and phase transitions. To mathematically understand these systems requires the use of powerful probabilistic ideas and techniques. The challenge is to introduce simple models, which serve as paradigms, and to unravel the complex random spatial structures arising in these models. Statistical physics and ergodic theory provide the conceptual ideas, while probability theory provides the mathematical language and framework. The important challenge is to give a precise mathematical treatment of the physics that arises from the underlying complexity. Much of the knowledge that has been built up in mathematical statistical physics over the past decades is currently making its way into biology. One of the tasks is to help facilitate this cross-fertilization and to address concrete biological questions at the interface. Examples are coming from population genetics and immune system biology.

The research in Probability Theory concentrated on interacting stochastic systems (disordered systems, percolation, random polymers, metastability, sandpiles), ergodic properties of random processes (dynamical Gibbs-non-Gibbs transitions, hidden Markov chains), and topics from mathematical biology (population dynamics, T-cells). Key tools are large deviation theory, stochastic analysis, variational calculus and combinatorics. There is an interesting link between algebraic dynamical systems and solvable models of statistical mechanics. It turns out that entropies of apparently different systems often coincide, and that this "mere" coincidence is not accidental. Research aims at providing an explanation for this phenomenon. A powerful combinatorial technique to study high-dimensional systyms is the "lace expansion". Research aims at obtaining a rigorous understanding of phase transitions in high dimensions, including diffusion on critical spatial structures.

The research in Operations Research concentrated on Markov chains, Markov decision processes and Markov games, with applications to problems in stochastic networks. One of the main issues concerns stability. How can stability be checked? If stable, how fast does the network reach its stationary distribution? If unstable, what does the quasi-stationary distribution look like? How can efficient algorithms be developed to control the network according to certain pre-set optimization criteria? Are these algorithms amenable to practical implementation? What can one say about the structure of optimal policies? Which type of customer should be prioritised to optimise network performance? These questions can be studied within the framework of Markov chain theory.

Often the situation arises where there are conflicting interests, for instance, maximizing server efficiency while minimizing customer dissatisfaction. This may be studied through Markov game models.

Research results in 2010

In 2010 F. den Hollander worked on the following projects:

With L. Avena, M. Hilario (Rio de Janeiro), H. Kesten (Ithaca), F. Redig and V. Sidoravicus (CWI):

Random walks in dynamic random environments driven by interacting particle systems.

With R. dos Santos and V. Sidoravicius (CWI):
Random walks in dynamic random environments with long-range transitions.

With F.R. Nardi (Eindhoven) and A. Troiani:
Metastability and nucleation for a two-dimensional lattice gas consisting of two types of particles subject to Kawasaki dynamics.

With S. Blachere (Utrecht) and J. Steif (Gothenburg):
Bad configurations for random walks in random sceneries.

With J. Gaertner (Berlin) and G. Maillard (Marseille):
Quenched Lyapunov exponents and intermittency for the Parabolic Anderson Model in a dynamic random environment.

With E. Bolthausen (Zürich) and A. Opoku:
Variational characterization of the critical curve separating the localized and the delocalized phase of a copolymer chain near a selective interface.

With A. Greven (Erlangen), S. Kliem (EURANDOM) and A. Klimovsky (EURANDOM):
Renormalization of hierarchically interacting Cannings processes.

With A. Gaudilliere (Marseille), F.R. Nardi (Eindhoven), E. Olivieri (Rome) and E. Scoppola (Rome):
Metastability and nucleation for the two-dimensional lattice gas subject to Kawasaki dynamics in large volumes.

With R. Fernandez (Utrecht) and J. Martinez:
Dynamical Gibbs-non-Gibbs transitions in mean-field models.

With M. Birkner (Mainz):
Scaling behavior of random polymers near random interfaces.

In 2010 M. Heydenreich worked on the following projects:

With R. Meester (Amsterdam):
Poisson matching.

With N. Berger (Jerusalem):
Diffusion constant of random walks on supercritical percolation clusters.

With T. Hulshof (Eindhoven) and R. van der Hofstad (Eindhoven):
Random walk on high-dimensional incipient infinite cluster.

With R. van der Hofstad (Eindhoven) and G. Miermont (Orsay):
Backbone convergence of high-dimensional incipient infinite cluster.

In 2010 F. Spieksma worked on the following projects:

Stability conditions for parametrised collections of Markov processes.

Structural properties of the value function in Markovian control problems. With S. Bhulai (VU).

Resource allocation in synchronised queueing models. With S. Bhulai (VU), Chretien Verhoef (CWI).

Graph measures for network robustness. With A Jamakovic (TNO), R.E. Kooij (TNO, TUDelft).

In 2010 E.Verbitskiy worked on the following projects:

Variational principles for fuzzy Gibbs measures.

Renormalization of Gibbs measures in one dimension.

With D. Lind (Seattle) and K. Schmidt (Vienna):
Entropy and growth rate of periodic points of algebraic Z^d-actions.

With A.C.D. van Enter (Groningen) and R. Fernandez (Utrecht):
Conditions for preservation of Gibbsianity.

With V. Ermolaev (Groningen):
Thermodynamic formalism and information theory.

Research Programme 2.3: Mathematical and Applied Statistics
Programme leader: R.D. Gill

Description of the project

Statistics is the art of drawing conclusions about phenomena in which chance plays a role. Randomness may arise through a variety of reasons: the intrinsic random nature of a phenomenon, unavoidable noise in an experiment, conscious randomization of experimental or measurement units, or as a best approximation to reality. Chance phenomena occur in a broad range of situations. This has rendered Statistical Science a highly multidisciplinary undertaking, but with a core body of concepts and methods that are common to the diverse applications. In the stochastics group at MI we concentrate on a few of the many strands in Statistical Science. Those chosen have in common that they represent areas of rapid development and strong relevance to science and society, and have substantial and challenging mathematical components. These are: forensic statistics; high throughput "omics" data; statistical and machine learning; and quantum statistics.

Forensic statistics is developing into a field of statistics with a rather special flavour, where neither classical frequentist nor classical Bayesian approaches fit the need to communicate the weight of evidence of some crime-related findings to a judge or jury. The focus lies on the likelihood ratio, and in the cases that the statistical analysis is really significant, this involves extrapolation into the tails of distributions, small data sets, and unreliable modelling. A particular example is given by estimating the probability of a random match of a DNA profile. Here the research relies also on statistical genetics and the probability models used in that area.

Development and applications of multivariate analysis/statistical learning techniques have especially been directed toward the field of systems biology, particularly genomics, transcriptomics, proteomics and metabolomics, where there is a high demand for data analysis techniques for high-volume data sets. These high-throughput "omics" data can be characterized as consisting of few objects compared to very many variables. Objects (e.g., patients) may cluster on small subsets of variables (e.g., measurements obtained by LC-mass spectrometry). Other interest is in the structure of fluorescence intensity data of SNP arrays. Modeling of this structure may result in parameter estimates that can be used to improve the results of "calling algorithms" that assign alleles to one of three genotypes.

In statistical learning/machine learning one deals with data arising from complex, often ill-understood phenomena. The aim is to find patterns in such data, and use these to predict future data, based on robust methods that make only few assumptions. Such methods can be very different in nature: they include structural risk minimization for classification and regression, but also nonparametric Bayesian methods. One may also use more traditional unions of parametric models combined with model selection and/or averaging procedures and analyze their behaviour under the assumption that they are all wrong, yet still useful in prediction. The research concerns both theoretical analysis of such methods and development of new, practical methods that combine the advantages of several existing ones.

Quantum statistics refers to the role of statistical inference for data on measurements from quantum systems. This field is making a rapid transition from a theoretical academic exercise to the laboratory and beyond, to technology, fueled by the rise of quantum information and quantum communication.

Research results in 2010
The year was focussed on setting up new research problems and a whole research programme in forensic statistics. Collaboration with R. Cowell, S. Lauritzen and J. Mortera led to improved statistical analysis of mixed DNA profiles which were also applied in a controversial Dutch murder case.

Collaboration with researchers at Danone (Wageningen) led to a new protocol for early stopping of a randomized clinical trial which is currently being used in a real-life clinical trial.

Outreach work on communicating statistics to the public led to work on the infamous Monty Hall (three door) problem. Despite the simplicity of this elementary and well known probability puzzle, it was possible to find completely new solutions using game theory.

Grünwald continued work on the switch distribution, a method that outperforms standard Bayesian model averaging when models are wrong. This is joint work with S. de Rooij (Cambridge, CWI) and T. van Erven (CWI). He also worked with W. Kotlowski on the behaviour of ML estimators for exponential families when the models are wrong.
Finally, Grünwald started work on his VICI project safe statistics with an initial investigation into the behaviour of the `robust' p-values defined by, among others, Vovk and Berger.

Unlike most statistical methods, which are based on assumptions about a “true" underlying probability distribution, Minimum Description Length (MDL) methods are designed to optimize an information theoretic criterion. Although it is known that both design criteria tend to lead to similar statistical performance, there do exist cases where they disagree. In his thesis, defended in 2010, Van Erven analyzes two such cases.
In the first case it is found that a standard MDL method can be improved, both from a information theoretic and a probabilistic point of view, after which the two criteria turn out to agree after all. In the second case the disagreement turns out to be fundamental.

Project Mathematics, Computer Science and Society
Project leader: F.A.J. Birrer

Description of the project

Research area:
Mathematics & Society, Computer Science/Chemistry/Science & Society.
Mission/themes:
Understanding and supporting argumentative, procedural and ethical quality in societal debate, deliberation and decision making that relate to (or draw upon) science and technology, particularly information technology, mathematical models and statistics, environmental issues and biotechnology

Research results in 2010

The collaboration with Wouter Mensink was continued, resulting in more work on the Dutch Electronic Health Record, this time with the emphasis on argumentation analysis. Another study addressed the Personal Health Budget, with the same emphasis. Both studies articulate various argumentative traps in the policy discourse.

Kloosterman Professor

In 1986 the Mathematical Institute established a visiting professorship in Mathematics, for two months a year, called the Kloosterman Chair. Hendrik Douwe Kloosterman was born on April 9, 1900. After studying in Leiden, Copenhagen, Oxford, Göttingen and Hamburg, he was appointed "lector" in Leiden in 1930 and full professor in 1947. He died on May 6, 1968. He is mostly known for his work in analytic number theory on what we now call "Kloosterman sums".

The Kloosterman Chair 2010 was occupied by professor Keith Promislow of the Department of Mathematics of Michigan State University, East Lansing, Michigan, USA. Keith Promislow was a graduate student at Indiana University with Roger Temam (Université de Paris XI and Indiana University), has been a postdoc in Paris, and has held positions at various universities in the US and in Canada. Professor Keith Promislow can be considered as one of the leading researchers of his generation in the field of the evolution of infinite dimensional dynamical systems. In his work, he exhibits a unique combination of deep fundamental analytical research with investigations of an explicit applied nature.

The visit of professor Promislow to Leiden was split into two parts: a six-seven weeks visit in May/June and a 10-day visit in August. During this second visit he co-organized -- with Arjen Doelman (his host) and Stephen J. Paddison (Chemical and Biomolecular Engineering, University of Tennessee) -- a workshop at the Lorentz Center, titled "Poly and Polymer Electrolytes for Energy Conversion: Ab Initio, Molecular, and Continuum Models" The goal of this workshop was to bring together the diverse international community of computational material scientists, computational chemists, and applied and computational mathematicians to address the fundamental thermodynamics which drives the structure function relationships in existing and novel nanostructured materials. The workshop was successful, it attracted many participants from abroad (mainly the USA); moreover, it for instance also had a remarkable number of participants from the Leiden Institute of Chemistry.

During the first visit, professor Promislow had many interactions with applied mathematicians, especially PhD students from the Mathematical Institute of Leiden University, but also at the CWI, that he visited a number of times. He has been invited for lectures at the Free University and the University of Twente. On May 20, 2010, professor Promislow presented the Kloosterman lecture, titled "Higher Order Geometric Flows: Models of Nanoscale Network Formation" for a general audience. As was intended with the appointment of professor Kloosterman, The lecture not only attracted mathematicians but also chemists and physicists.

Professor Promislow's visit can be considered as a great success. An additional indication of this is the fact that he visited the Netherlands a third time in 2010, in December. Based on his interactions with Dutch mathematicians during his first two visits he has been invited as a speaker in the winterschool "Evolution Equations in an Applied Context" that was organized by the "wiskunde cluster" $NDNS^{+}$ at the University of Twente in the week of December 13-17, 2010. During this school he taught eight hours on the subject "Geometric Evolution of Structured Interfaces" for a group of 20-25 PhD (mostly Dutch) students and postdocs.

International and National Programmes

***International Programmes**:*

Erasmus Mundus Master program Algebra, Geometry and Number Theory.
2005-2010.
Cooperation with Bordeaux and Padova and Orsay.
See: www.math.u-bordeaux1.fr/ALGANT/.
Coordinators: P. Stevenhagen, S.J. Edixhoven.

Erasmus Mundus Master program Algebra, Geometry and Number Theory.
2010-2015.
Cooperation with Bordeaux and Padova and Orsay, Milano, Stellenbosch and Montreal.
See: www.math.u-bordeaux1.fr/ALGANT/.
Coordinators: P. Stevenhagen, S.J. Edixhoven.

Dutch-German Bilateral Research Group (NWO-DFG): Mathematics of Random Spatial Models from Physics and Biology.
2003-2010.
Cooperation with E. Baake (Bielefeld), A. Bovier (Berlin), F. Götze (Bielefeld), A. Greven (Erlangen) and A. Wakolbinger (Frankfurt).
Project leader: W.Th.F. den Hollander.

ERC grant: Variational Approach to Interacting Stochastic Systems
2011-2015
Project leader: W.Th.F. den Hollander

Long term collaboration with Tokyo Metropolitan University in the project
Algebras associated with dynamical systems. The collaboration is supported
by an NWO visitor's grant for Prof.Em. J. Tomiyama.
Coordinator: M.F.E. de Jeu.

Generalizing results on invariant measures for HJMM forward rate models,
Exchange grant of the Advanced Mathematical Methods in Finance programme
by the European Science Foundation,
February 15 - May 10,
support for a research visit of A. Rusinek (Warsaw).
Project leader: O.W. van Gaans

FOM Programme Active Control of Magneto-hydrodynamic modes in Burning Plasmas
B. Koren (co-leader)

FP6 Research and Training Network: Galois Theory and Explicit Methods.
October 2006 - October 2010.
Cooperation with: Barcelona, Bordeaux, Essen, Heidelberg, Lausanne, Leuven, Lille, Nottingham, Paris, Rome, Tel Aviv.
Project leader: B. de Smit.

Multivariate clustering in high-volume data sets.
With Jerome H. Friedman, Stanford University.
Project leader: J.J. Meulman.

Development of user-friendly software for nonlinear multivariate data analysis by optimal scaling transformations.
With SPSS Inc, Chicago.
Project leader: J.J. Meulman.

PASCAL2 (European Network of Excellence)
2008-2012.
Project leaders: P. Grünwald and J.J. Meulman

Erasmus programme Bilateral Agreement with Universita degli Studi di Padova.
Project leader: J.J. Meulman

***National Programmes**:*

NWO cluster: Discrete, interactive & algorithmic mathematics, algebra and number theory. (DIAMANT).
Project leader: P.Stevenhagen.

NWO VICI-premie: The Mathematics of Secure Computation
1/4/2007-1/4/2013
Project leader: R. Cramer

NWO VIDI-premie Stationary dynamics in infinite dimensions
1/1/2006-1/1/2011
Project leader: O.W. van Gaans

NWO Vrije Competitie project: Banach algebra dynamical systems and positivity
1/9/2009-1/9/2013
Project leader: M. de Jeu

NWO VENI-project The Shafarevich conjecture made effective
January 2007-January 2010
Projectleader: R.S. de Jong

NWO VENI-project Special Values and t-Motives
July 2010-July 2013
Project leader: L. Taelman

NWO Veni-grant: Random spatial models at the critical point
2011-2014
project leader: M. Heydenreich

NWO VIDI-premie: Formation of singularities in natural systems
1/1/2007-1/1/ 2012.
Project leader: V. Rottschäfer.

NWO VICI Project Safe Statistics.
1/7 2010 - 1/7 2015
Project Leader: P. Grünwald

Participation in the national stochastics cluster STAR: Stochastics - Theoretical and Applied Research
2009-2011.
Project leader: W.Th.F. den Hollander

Random Walks on high-dimensional incipient infinite clusters
2009-2010
Project leader: W.Th.F. den Hollander with R. van der Hofstad

Random Polymers
2010-2011
Project leader: W.Th.F. den Hollander with V. Sidoravicius

Variational characterization of copolymers near selective interfaces
2010-2012
Project leader: W.Th.F. den Hollander with V. Sidoravicius

The Plant BioDynamics Laboratory (PBDL).
Cooperation with the Institute for Biology Leiden (IBL)
Project leader: L.A. Peletier

Critical transitions and early-warning signals in spatial ecosystems
Cooperation between A. Doelman (PI), J. Rademacher (CWI) en M. Rietkerk (Environmental Sciences, Utrecht).

NWO programme 'ERGO' project: Quantifying introgression risks of transgenes with hazard rates, using carrot as a model species
2008-2012
Collaboration with CML and IBL (Leiden univeirsity)
Project leader: P. Haccou

NWO programme 'CLS' project: The evolution of stochastic heterogeneous networks as bet-hedging adaptations to fluctuating environments
2009-2011
Collaboration with CML and LIACS (Leiden university) and Groningen Biomolecular Sciences and Biotechnology Institute (University of Groningen)
Project leader: P. Haccou

Development and application of statistical learning techniques for biomedical high-volume data sets. With Th. Hankemeier, LACDR (Leiden-Amsterdam Center for Drug Research) and Metabolomics Center, Leiden, J. van der Greef, TNO Quality of Life, Zeist, and D. Boomsma, Department of Biological Psychology, VU University Amsterdam. Sponsored by NDNS+ (NWO).
Project leader: J.J. Meulman

Glucose modeling in patients with diabetes and critically-ill patients,
joint with AMC (UvA), UMCG (RuG)
E. Verbitskiy

Master Theses

S.C. Raynor
title: The Rieman-Roch theorem is a special case of the Atiyah-Singer index formula
advisor: Dr. M. Lübke
date: 05-03-2010

T. Vorselen
title: On Kronecker's theorem over the adèles
advisor: Dr. J.-H. Evertse
date: 27-04-2010

H.P. Chang
title: Asymptotically good generalized algebraic geometry codes
advisor: Dr. R.S. de Jong
date: 11-06-2010

I. Varma
title: Sums of squares, modular forms, and Hecke characters
advisor: Prof.Dr. S.J. Edixhoven
date: 18-06-2010

M.F. Kosters
title: Anisotropic modules and the integral closure
advisor: Prof.Dr. H.W. Lenstra
date: 21-06-2010

L. de Boer
title: What makes fish school?
advisor: Dr. S.C. Hille
date: 16-08-2010

Fan Shi
title: Asymptotic blowup vortex solutions of the NLS
advisor: Dr. V. Rottschäfer
date: 20-08-2010

A.C. Snel
title: Optimal trading strategy for storage systems
advisor: Dr. F.M. Spieksma
date: 24-08-2010

M. Irwin
title: Short-term revenue forecasting at KLM
advisor: Dr. F.M. Spieksma
date: 27-08-2010

J.P. van der Horst
title: Finding ABC-triples using elliptic curves
advisor: Dr. B. de Smit
date: 27-08-2010

H. Nooitgedagt
title: Two convergence limits of Markov chains: Cutoff and Metastability
advisor: Prof.Dr. W.Th.F. den Hollander
date: 31-08-2010

R. de Jong
title: Ordered Banach algebras
advisor: Dr. M.F.E. de Jeu
date: 30-09-2010

A. Stolwijk
title: Solution concepts in cooperative game theory
advisor: Dr. F.M. Spieksma
date: 12-10-2010

A.G.H. Hauwert
title: Time dependent optimization problems in networks
advisor: Dr. F.M. Spieksma
date: 10-11-2010

J. Michielsen
title: L-functions of the projective line
advisor: Prof. Dr. H.W. Lenstra
date: 09-12-2010

G.F. van Helden
title: Ship scheduling at seatrade Reefer chartering
advisor: Dr. F.M. Spieksma
date: 15-12-2010

ALGANT Master Theses

The ALGANT MASTER is a two-year master programme in pure mathematics, with a strong emphasis on Algebra, Geometry and Number Theory. It has been offered since September 2005, and it involves the partner universities of Bordeaux (France), Leiden (Holland), Milano (Italy), Padova (Italy) and Paris-Sud (France). It is a European Erasmus Mundus Master and provides European Community grants to students from non-EC-countries.

Every student participating in the Algant Master studies one year each in TWO of the four partner universities. At the end of the second year, the student defends a master thesis and is awarded the Algant master diploma in an Algant Graduation Ceremony.

Duong Hoang Dung
title: Equivariant Gröbner Bases
advisor: Dr. J. Draisma
date: 16-06-2010

A. Javanpeykar
title: The Grothendieck Riemann-Roch Theorem
advisor: Prof.Dr. J.P. Murre
date: 17-06-2010

V. Pastro
title: Construction of ration elliptic surfaces with Mordell-Weil Rank 4
advisor: Dr. C. Salgado Guimaraes de Silva
date: 28-06-2010

R. Rainone
title: On the inverse problem for deformation rings of representations
advisor: Dr. B. de Smit
date: 28-06-2010

N.Sambin
title: Geometric constructions of the irreducible representations of $GL_m(C)$
advisor: Dr. R.S. de Jong
date: 28-06-2010

M. Zordan
title: On Galois extensions generated by radicals
advisor: Prof.Dr. H.W. Lenstra
date: 28-06-2010

A. Zottarel
title: Encryption from weaker assumptions
advisor: Dr. E. Kiltz
date: 28-06-2010

PhD Theses

W.H. Ekkelkamp	On the amount of sieving in factorization methods
January 20, 2010	Thesis advisor: prof.dr. R. Tijdeman
	Leiden University
J. Bierkens	Long Term Dynamics of Stochastic Evolution Equations
February 9, 2010	Thesis advisor: prof.dr. S.M. Verduyn Lunel
	Leiden University
M. Muskulus	Distance-based analysis of dynamical systems and time series
February 11, 2010	Thesis advisor: prof.dr. S.M. Verduyn Lunel
	Leiden University
T.C. Streng	Complex multiplication of abelian surfaces
June 1, 2010	Thesis advisor: prof. dr. P. Stevenhagen
	Leiden University
I. Smeets	On continued fraction approximations
June 16, 2010	Thesis advisor: prof.dr. R. Tijdeman
	Leiden University
P. J. Bruin	Modular curves, Arakelov theory, algorithmic applications
September 1, 2010	Thesis advisor: prof. dr. S.J. Edixhoven
	Leiden University
D.T.H. Worm	Semigroups on Spaces of Measures
September 16, 2010	Thesis advisor: prof.dr. S.M. Verduyn Lunel
	Leiden University
L. Avena	Random Walks in Dynamic Random Environments
October 26, 2010	Thesis advisor: prof.dr. W.Th.F. den Hollander
	Leiden University
T. van Erven	When Data Compression and Statistics Disagree: Two Frequentist Challenges for the Minimum Description Length Principle
November 23, 2010	Thesis advisor: prof.dr. P.D. Grünwald
	Leiden University

Publications

1. Number theory, Algebra and Geometry

1.1 Number Theory and Algebra

Papers in Journals and Proceedings

Cramer,R., Hofheinz, D., Kiltz, E., A Twist on the Naor-Yung Paradigm and Its Application to Efficient CCA-Secure Encryption from Hard Search Problems, *7th Annual IACR Theory of Cryptography Conference (TCC 2010), Springer Lecture Notes in Computer Science 5978 (2010), 146-164.*

Dalen, B. van, The boundary and shape of binary images, *Discrete Mathematics 310 (2010) 2910-2918.*

Evertse, J.-H., On the Quantitative Subspace Theorem, *Zapiski Nauchnyk Seminarov, POMI 377 (2010), 217-240.*

Hancl, J., Tijdeman,R., On the irrationality of factorial series III, *Indag. Math. N.S. 20 (2009), 537-549.*

Hancl, J., Tijdeman, R., On the irrationality of factorial series II, *J. Number Th. 130 (2010), 595-607.*

Kraaikamp, C., Schmidt, Th.A., Smeets, I., Natural extensions for α-Rosen continued fractions, J. Math. Soc. Japan 62 (2) (2010), 649-671.

Kraaikamp, C., Smeets, I., Approximation results for α-Rosen fractions, Uniform Distribution Theory 5 (2)(2010), 15-63.

Lenstra, H.W., Irreducible cubics modulo five, *Amer. Math. Monthly 117 (2010) 817-821.*

Luijk, R. van, Schuett, M., Shioda, T., Lines on Fermat surfaces, *Journal of Number Theory, 130 (9)(2010), 1939-1963.*

Luijk, R.van, Logan, A., McKinnon, D., Density of rational points on diagonal quartic surfaces, *Algebra and Number Theory 4(1) (2010), 1-20.*

Najman, F., The Diophantine equation $x^4+y^4=iz^2$ in Gaussian integers, *Amer. Math. Monthly 117 (2010), 637-641.*

Najman, F., Complete classification of torsion of elliptic curves over quadratic cyclotomic fields, *J. Number Theory 130 (2010), 1964-1968.*

Najman, F., Compact representation of quadratic integers and integer points on some elliptic curves, *Rocky Mountain J. Math. 40 (2010), 1979-2002.*

Najman, F., Smooth values of some quadratic polynomials, *Glasnik Mat. Ser III 45 (2010), 347-355.*

Shorey, T.N., Tijdeman, R., Generalizations of some irreducibility results by Schur, *Acta Arith. 145 (2010), 341-371.*

Smit, B. de, Gornet, R., Sutton, C., Sunada's method and the covering spectrum, *J. Differential Geom. 86 (2010), (3), 501-537*

PhD Thesis

W.H. Ekkelkamp, On the amount of sieving in factorization methods, defended on January 20.

I. Smeets, On continued fraction approximations, defended on June 16.

T.C. Streng, Complex multiplication of Abelian surfaces, defended on June 1.

Other publications

Smit, B. de, Florence, M., Thomas, L., The valuation criterion for normal basis generators, *arXiv:1004.2480v1 [math.NT]*.

Smit, B. de, Gornet, R., Sutton, C., Isospectral surfaces with distinct covering spectra via Cayley Graphs, *arXiv:1006.5414v1 [math.DG]*.
Smit, B. de, Bleher, F., Chinburg, T., Inverse Problems for deformation rings, *arXiv:1012.1290v1 [math.NT]*.

Books
Smeets, I., A Tale of Two Papers, In: The LLL Algorithm - Survey and Applications, (Nguyen, Phong Q., Vallée, B. eds.), 2010, XIV, 496 p.

1.2 Arithmetic Geometry

Papers in Journals and Proceedings
Edixhoven, S.J., On the computation of the coefficients of modular forms, *Proceedings of the Fifth European Congress of Mathematics, (A. Ran, H. te Riele, J. Wiegerinck eds.), Eur. Math. Soc., Zürich (2010), 17-29.*
Edixhoven, S.J., Jong, R.S. de, Schepers, J., Covers of surfaces with fixed branch locus, *Int. Jnl. Math 21(7) (2010), 859-874.*
Jong, R.S. de, Admissible constants for genus 2 curves, *Bulletin of the LMS 42 (2010), 405-411.*
Jong, R.S. de, Theta functions on the theta divisor, *Rocky Mountain Jnl. Math. 40 (2010), 155-176.*
Kimura,S., Murre,J.P. , On natural isomorphisms of finite dimensional motives and applications to the Picard motives, in "Cycles, Motives and Shimura varieties" (V. Srinivas, editor) , a Publication of the Tata Institute of Fundamental Research, Mumbai, India (2010).
Taelman, L., A Dirichlet unit theorem for Drinfeld modules, *Math. Ann. 348 (2010), 899-907.*

PhD Thesis
P.J. Bruin, Modular curves, Arakelov theory, algorithmic applications, defended on September 1.

2. Analysis and Stochastics

2.1 Analysis and Dynamical Systems

Papers in Journals and Proceedings
Andersen, N.B., Jeu, M.de, Real Paley-Wiener theorems and local spectral radius formulas, *Trans. Amer. Math. Soc. 362(7) (2010), 3613-3640.*
Bierkens, J., Gaans, O. van, Verduyn Lunel, S.M., Estimate on the pathwise Lyapunov exponent of linear stochastic differential equations with constant coefficients, *Stochastic Analysis and Applications 28 (2010), 747-762.*
Es-Sarhir, AS., Scheutzow, M., Gaans, O. van, Invariant measures for stochastic functional differential equations with superlinear drift term, *Differential Integral Equations 23 (1-2) (2010), 189-200.*
Gaans, O. van, Kalauch, A., Tensor products of Archimedean partially ordered vector spaces, *Positivity 14 (4)(2010), 705-714.*
Ghosh, A., Haccou, P, Quantifying stochastic introgression processes with hazard rates. *Theoretical Population Biology 77 (2010), 171-180.*

Heijster, P.J.A. van, Doelman, A., Kaper, T.J., Promislow, K., Front interactions in a three-component system, *SIAM J. Appl. Dyn. Syst. 9 (2) (2010), 292-332*.
Herrmann, M., Rademacher, J.D.M., Heteroclinic travelling waves in convex FPU-type chains, SIAM J. Math. Ana. 42 (2010), 1483-1504.
Herrmann, M., Rademacher, J.D.M., Riemann solvers and undercompressive shocks of convex FPU chains, Nonlinearity 23 (2010), 277-304.
Kreeft, J.J., Koren, B., A new formulation of Kapila's five-equation model for compressible two-fluid flow, and its numerical treatment, *Journal of Computational Physics 229(2010), 6220-6242* .
Peletier, L.A., Benson, N., Graaf, P.H. van der, Impact of protein binding on receptor occupancy: A two-compartment model, *Journal of Theoretical Biology 265 (2010) 657-671.*
Rademacher, J.D.M., Lyapunov-Schmidt Reduction for Unfolding Heteroclinic Networks of Equilibria and Periodic Orbits with Tangencies, J. Diff. Eq. 249 (2010), 305-348.
Rottschäfer, V., De uitdagende vraagstukken van bedrijven, Wiskunde: de uitdaging, *CWI syllabus 60, pp. 55–64.*
Sanderse, B., Koren, B., Analysis of fourth-order accurate symmetry-preserving boundary conditions for the incompressible Navier-Stokes equations, Proceedings ECCOMAS Computational Fluid Dynamics Conference (ECCOMAS CFD10, on CD-ROM).
Sherratt, J.A., Smith, M.J., Rademacher, J.D.M., Patterns of Sources and Sinks in the Complex Ginzburg-Landau Equation with Zero Linear Dispersion, SIAM J. Appl. Dyn. Syst. 9 (2010), 883-918.
Thornton, A., Weinhart, Th., Bokhove,O., Zhang, B., Sar, D.M. van der, Kumar, K., Pisarenco, M., Rudnaya, M., Savcenco, V., Rademacher, J., Zijlstra, J., Szabelska, A., Zyprych, J., Schans, M. van der, Timperio, V., Veerman, F., Modeling and Optimization of Algae growth, *Proceedings studygroup Mathematics with Industry, Amsterdam 2010, 54-85.*

PhD Thesis
J. Bierkens, Long Term Dynamics of Stochastic Evolution Equations, defended on February 9.
M. Muskulus, Distance-based analysis of dynamical systems and time series, defended on February 11.
D.T.H. Worm, Semigroups on Spaces of Measures, defended on September 16.

Books
Dijk, G. van, Wakayama, M. (eds.), Casimir Force, Casimir Operators and the Riemann Hypothesis, W. de Gruyter, Berlin (2010).
Koren,B., Numerieke Wiskunde: Wetenschap en Gereedschap, oratie on October 22.

2.2 Probability Theory

Papers in Journals and Proceedings
Avena, L., Hollander, F.den, Redig, F., Large deviation principle for one-dimensional random walk in dynamic random environment: attractive spin-flips and simple symmetric exclusion, *Markov Proc. Relat. Fields 16 (2010), 139-168.*
Birkner, M., Greven, A., Hollander, F. den, Quenched large deviation principle for words in a letter sequence, *Probab. Theory Relat. Fields 148 (2010), 403-456.*
Bovier, A., Hollander, F.den, Spitoni, C., Homogeneous nucleation for Glauber and Kawasaki dynamics in large volumes at low temperatures, *Ann. Probab. 38 (2010), 661-713*.
Enter, A.C.D. van, Verbitskiy, E., Erasure Entropies and Gibbs Measures, *Markov Processes Relat. Fields 16 (2010), 3-14.*

Enter, A.C.D. van, Fernandez, R., Hollander, F. den, Redig, F., A large-deviation view on dynamical Gibbs-non-Gibbs transitions, *Moscow Mathematical Journal 10 (2010) 687-711.*
Gärtner, J., Hollander, F. den, Maillard, G., Intermittency on catalysts: voter model, *Ann. Probab. 38 (2010), 2066-2102.*
Giardina, C., Redig, F., Vafayi, K., Correlation Inequalities for Interacting Particle Systems with Duality, Journal of Statistical Physics 141(2010), 242-263.
Hoekstra, M., Vogelzang, M., Verbitskiy, E., Nijsten, M.W.N., Hourly measurements not required for safe and effective glycemic control in the critically ill patient, *Critical Care 14, 404 (2010).*
Hollander, F. den, Pétrélis, N., A mathematical model for a copolymer in an emulsion, *J. Math. Chem. 48 (2010), 83-94.*
Hollander, F. den, A key large deviation principle for interacting stochastic systems, *Proceedings of the International Congress of Mathematicians, Hyderabad, India, August 19-27, 2010, Vol. IV, 2258-2274, Hindustan Book Agency, New Delhi, 2010.*
Redig, F., Roelly, S., Ruszel, W., Short-Time Gibbsianness for Infinite-Dimensional Diffusions with Space-Time Interaction, Journal of Statistical Physics 138(2010), 1124-1144.
Redig, F., Wang, F., Transformations of one-dimensional Gibbs measures with infinite range interaction, Markov Processes and Related Fields 16 (2010), 737-752.
Verbitskiy, E., Tuyls, P., Obi, C., Skoric, B., Schoenmakers, B., Key Extraction From General Non-Discrete Signals, *IEEE Trans. on Information Forensics and Security 5(2) (2010), 269-279.*
Verbitskiy, E., Mathematics in the industrial environment: Dutch perspective, *Theoretical Casimir Force, Casimir Operators and the Riemann Hypothesis. G. van Dijk, M. Wakayama (eds.), Verlag Walter de Gruyter GmbH, 21-28 (2010).*
Verbitskiy, E., Variational Principle for Fuzzy Gibbs Measures, *Moscow Mathematical Journal 10 (4) (2010).*

PhD Thesis
L. Avena, Random Walks in Dynamic Random Environments, defended on October 26.

Other publications
Hollander, F. den, Oprichting Platform Wiskunde Nederland, *Nieuw Archief voor Wiskunde 5/11 (2010), 168-172.*

2.3 Mathematical and Applied Statistics

Papers in journals and proceedings
Draisma, H.M., Reijmers, T.H., Van der Kloet, F., Meulman, J.J., et al, Equating, or correction between-block effects with application to body fluid LC-MS and NMR metabolomics data sets, *Analytical Chemistry, 82 (2010),1039-1046*.
Gill, R.D., Lies, damned lies, and legal truths, *in: L. Mommers, H. Franken, J. van den Herik, F. van der Klaauw and G.J. Zwenne (eds.), Het Binnenste Buiten (Liber Amicorum ter Gelegenheid van het Emeritaat van Aernout Schmidt), 39-50.*
Grünwald, P.D., Kotlowski, W., Prequential Plug-In Codes that Achieve Optimal Redundancy Rates even if the Model is Wrong, *Proceedings of the International Symposium on Information Theory (ISIT 2010), Houston, Texas, 2010, 1383-1387.*
Kotlowski, W., Grünwald, P.D., Rooij, S. de, Following the Flattened Leader, *Proceedings of the 23rd Conference on Learning Theory (COLT 2010), Haifa, 2010, 106-118.*
Kruijer, W.J., Rousseau, J., Vaart, A.W. van der, Adaptive Bayesian density estimation with location-scale mixtures, Electronic Journal of Statistics 4, 1225-1257.

Lombardo, R., Meulman, J.J., Multiple correspondence analysis via polynomial transformations of ordered categorical variables, *Journal of Classification*, *27(2010), 191-210.*
Vaart, A.W. van der, Bayesian Regularization, Proceedings of the International Congress of Mathematicians, Hyderabad, India, 2010, (Rajendra Bhatia, Arup Pal, G Rangarajan, V Srinivas, M Vanninathan eds.), World Scientific.
Zohren, S., Reska, P., Gill, R.D., Westra, W., A tight Tsirelson inequality for infinitely many outcomes, *Europhysics Letters 90 (2010), 10002, 4p.*

PhD Thesis
T. van Erven, When Data Compression and Statistics Disagree: Two Frequentist Challenges for the Minimum Description Length Principle, defended on November 23.

3. Mathematics, Computer Science and Society

Papers in Journals and Proceedings
Mensink, W., Birrer, F.A.J., The role of expectations in systems innovation: the Electronic Health Record, immoderate goal or achievable necessity?, *Central European Journal of Public Policy 4 (1) (2010), 36-59.*
Dutilleul, B., Birrer, F.A.J., Mensink, W., Unpacking European Living Labs: analysing innovation's social dimensions, *Central European Journal of Public Policy 4 (1) (2010), 60-85.*
Mensink, W., Birrer, F.A.J., The role of expectations in radical system innovation: the Electronic Health Record, immoderate goal or achievable necessity?, *in: K.Müller, S.Roth, M.Žák (eds.): Social dimension of innovation, 2010, Centre for Economic Studies, Prague, 142-157.*
Dutilleul, B., Birrer, F.A.J., Mensink, W., Unpacking European Living Labs: analysing innovation's social dimensions, *in: K.Müller, S. Roth, M. Žák (eds.): Social dimension of innovation, 2010, Centre for Economic Studies, Prague, 87-105.*

Mathematical Institute Reports

MI 2010-01
O. van Gaans, A. Kalauch
Tensor products of Archimedean partially ordered vector spaces

MI 2010-02
D.T.H. Worm, S.C. Hille
An ergodic decomposition defined by regular jointly measurable Markov semigroups on Polish spaces

MI 2010-03
D.T.H. Worm, S.C. Hille
Equicontinuous families of Markov-Feller operators on Polish spaces with applications to ergodic decompositions and existence, uniqueness and stability of invariant measures

MI 2010-04
O. van Gaans, I. Stojkovic
Invariant measures and a stability theorem for locally Lipschitz stochastic delay equations

MI 2010-05
F. den Hollander
A key large deviation principle for interacting stochastic systems

MI 2010-06
I. Stojkovic
Approximations for convex functional on metric spaces of non-positive curvature

MI 2010-07
M. Birkner, A. Greven, F. den Hollander
Collision local time of transient random walks and intermediate phases in interacting stochastic systems
(revised version)(MI 2008-19)

MI 2010-08
R. de Jong
Second variation of Zhang's λ-variant on the moduli space of curves

MI 2010-09
T. Szarek, D. Worm
Ergodic measures of Markov semigroups with the e-property

MI 2010-11
AC.D. van Enter, R. Fernàndez, F. den Hollander, F. Redig
A large-deviation view on dynamical Gibbs-non-Gibbs transitions

MI 2010-12
D. Cheliotis, F, den Hollander
*Variational characterization of the critical curve for pinning of random polymer*s

MI 2010-13
I. Stojković
Wasserstein-2 Analysis of the non-symmetric Fokker-Planck equation and the Trotter Product Formula

MI 2010-14
I. Stojković
Kato product formula approximation for convex functional on non positively curved spaces and the Trotter-Kato product formula
(*revised version)(MI 2010-06)*

MI 2010-15
J. Gärtner, F. den Hollander,G. Maillard
Quenched Lyapunov exponent for the parabolic Anderson model in a dynamic random environment

MI 2010-16
T. Alkurdi, S.C. Hille, O. van Gaans
On metrization of unions of function spaces on different intervals

MI 2010-17
J.-H. Evertse
A further improvement of the quantitative subspace theorem

MI 2010-18
M.N. Spijker, W. Hundsdorfer, A. Mozartova
Stepsize restrictions for boundedness and monotonocity of multistep methods

MI 2010-19
M.N. Spijker, W. Hundsdorfer, A. Mozartova
Special boundedness properties in numerical initial value problems

MI 2010-20
N.B. Andersen, M.F.E. de Jeu
Local spectral radius formulas for a class of unbounded operators on Banach spaces

Workshops, Seminars a.o.

This chapter summarizes the workshops, seminars and others (co-) organised by (researchers of) the Mathematical Institute. The following data are given:
- *Title*
- *City and date*
- *(Co-) organisers*

CWI/LEIDEN Research on Information Security and Cryptology Seminar (RISC)
scheduled regularly
Organizer: R. Cramer

Banach algebras
Leiden, regularly scheduled seminar,
Organizer: M.F.E. de Jeu

Edixhoven participates in the organisation of the Cryptography seminar of the university of Rennes and the CELAR (Centre Electronique de l'Armement), since December 2001.
See: www.math.univ-rennes1.fr/crypto/seminaire.html

Intercity number theory seminar
14 meetings in 2010 in Leiden, Amsterdam, Utrecht, Nijmegen, Groningen, Eindhoven
Organizer: B. de Smit
webpage: http://www.math.leidenuniv.nl/~desmit/ic

Workshop on Physical Security, Lorentz Center, Leiden University, Leiden, The Netherlands, February 15-19
Organizer: R. Cramer with S. Goldwasser (MIT/Weizmann), D. Naccache (ENS), F.-X. Standaert (Louvain), E. Kiltz (CWI), K. Pietrzak (CWI).

Workshop Nonlinear Dynamics of Natural Systems,
Singular solutions of the generalised Korteweg-de Vries equation,
Eindhoven, April 13-16
V. Rottschäfer

Workshop on Public Key Cryptography and Geometry of Numbers.
KNAW Trippenhuis, Amsterdam, The Netherlands, May 6-7
Organizer: R. Cramer with D. Freeman (Stanford).

Joint SIAM/RSME-SCM-SEMA Meeting
Emerging Topics in Dynamical Systems and Partial Differential Equations,
Amplitude equations for systems with a conservation law
Barcelona, Spain, May 31-June 4

Fifth European Conference on Computational Fluid Dynamics (ECCOMAS CFD 2010)
Lisbon, Portugal, June 14-17
B. Koren (member Organizing Committee and Scientific Committee):

Numeration
Leiden, Lorentz Center, DIAMANT-Stieltjes Instructional Conference, from 7 to 11 June,

Workshop from 14 to 18 June
Organizer: K. Dajani (UU), R. Fokkink (TUD), C. Kraaikamp (TUD), R. Tijdeman (UL)

Sage Days 23: Number Theory and Computer Algebra
5 Jul 2010 - 9 Jul 2010, Lorentz Center, Leiden
Scientific organizers: W. Bosma (Nijmegen), B. de Smit (Leiden), W. Stein (Seattle)

Advanced Topics in Statistics, Department of Statistics, Stanford University,
June-August 2010.
J.J. Meulman

Workshop "Poly and Polymer Electrolytes for Energy Conversion: Ab Initio, Molecular, and Continuum Models",
August 23-27, Lorentz Center, Leiden
Organizers: A. Doelman (Leiden), K. Promislow (East Lansing, USA), S. Paddison (Knoxville, USA)

Galois Theory and Explicit Methods, final conference
Barcelona, Sep 6 - Sep 10, 2010
Scientific Committee: P. Bayer (Barcelona), T. Crespo (Barcelona), P. Dèbes(Lille),
B. de Smit (Leiden)

Intercity Algebraic Geometry Seminar
6 meetings in different places in the Netherlands, Fall 2010
Organizers: R. de Jong and J. Heinloth (UvA)

Algebra, geometry and number theory seminar
Leiden, regularly scheduled seminar (10 meetings in Fall 2010)
Organizer: L. Taelman

Conference "Geometry and arithmetic"
Schiermonnikoog, September 20-24
Organizers: R. de Jong, C. Faber (KTH Stockholm), G. Farkas (Humboldt University Berlin)

Most Informal Probability Seminar
Biweekly meetings since October 2010
Organizer: M. Heydenreich

Arithmetic of Surfaces
Leiden, October 25-29
Organizers: H.W. Lenstra, R.M. van Luijk, C. Salgado, L.D.J. Taelman

Workshop on Crypto, Coding, and Geometry
CWI, Amsterdam, The Netherlands, November 18-19
Organizer: R. Cramer with A. Bassa (CWI) and I. Cascudo (CWI).

Invited lectures

1.1 Number theory and Algebra

R. Cramer
- Special Codes in Secure Multi-Party Computation and Complexity, and Their Relation to Algebraic Geometry, Aarhus, Denmark, October 13-15.
- Special Codes in Secure Multi-Party Computation and Complexity, and Their Relation to Algebraic Geometry, Tarragona, Spain, September 7-10.
- 8 lectures on Mathematical Aspects of Secure Multi-Party Computation, Singapore, October/November.

J.-H. Evertse
- On monogenic orders, Banff, Canada, June 6.
- Effective results on unit equations over finitely generated domains, Luminy, France, September 10.
- On monogenic orders, Debrecen, Hungary, October 4.

D.C. Gijswijt
- New coding bounds using quadruples, Tilburg, The Netherlands, June 15.
- Fractional matroid matching, Hammamet, Tunisia, March 24.

H.W. Lenstra
- Escher en het Droste-effect, Oegstgeest, The Netherlands, February 3.
- Anisotropic groups and integral closures, Amsterdam, The Netherlands, February 26.
- Escher en het Droste-effect, Groningen, The Netherlands, March 30.
- Wetenschappelijke bewijsvoering, Amsterdam, The Netherlands, April 26.
- Introduction to Lattices and the LLL Algorithm, Amsterdam, The Netherlands, May 6.
- Algorithmic aspects of elliptic curves, Bordeaux, France, July 16.
- Determining integral closures (several lectures), Berkeley, USA, July 26-30.
- Radical Galois groups, Leiden, The Netherlands, September 3.
- Escher en het Droste-effect, Leiden, The Netherlands, September 19.
- Numbers fields with the same abelian L-functions, Bonn, Germany, October 19.
- Escher and the Droste effect, Bonn, Germany, October 19.
- Escher en het Droste-effect, Den Bosch, The Netherlands, December 14.
- Fredgetallen, Eindhoven, The Netherlands, November 5.
- Escher and the Droste effect, Emmen, The Netherlands, November 9.
- Escher and the Droste effect, Heidelberg, Germany, December 16.
- Numbers fields with the same abelian L-functions, Heidelberg, Germany, December 17.

R.M. van Luijk
- Computing Picard groups of surfaces, Tokyo, Japan, February, 15.
- Computing Picard groups of surfaces, Leiden, The Netherlands, April 16. 2010.
- Computing Picard groups of surfaces, Zürich, Switzerland, May 25.
- Density of rational points on elliptic surfaces, Bonn, Germany, March 11.
- Unfaking the fake Selmer group, Cambridge, U.K., November 23.

F. Najman
- Compact representations of quadratic integers and consecutive smooth integers, Lunteren, The Netherlands, November 25.

B. de Smit

- Escher en het Droste-effect, Utrecht, The Netherlands, January 16.
- Escher and the Droste effect, Antwerpen, Belgium, March 17.
- Escher and the Droste effect, Plenary lecture at: the Third International Symposium and Workshops on "3D Diagnosis and Virtual Treatment Planning of Cranio-Maxillo-Facial Deformity", Eindhoven, The Netherlands, March 25.
- Grids for science: ABC@Home, Almere, The Netherlands, March 30.
- Deformation rings of group representations, Leiden, The Netherlands, April 16.
- Escher and the Droste effect, Princeton, U.S.A., April 29.
- Deformation rings of group representations, Princeton, U.S.A., April 29.
- Experiments with the ABC conjecture, Princeton, U.S.A., April 30.
- The covering spectrum of Riemannian manifolds, Utrecht, The Netherlands, May 21.
- Zicht en Inzicht, Groningen, The Netherlands, September 25.
- Escher en het Droste effect, Leiden, The Netherlands, October 13.
- Escher en het Droste effect, Leiden, The Netherlands, October 16.
- Escher and the Droste effect, Stockholm, Sweden, November 12.

P. Stevenhagen

- Low genus curves and Jacobians of prescribed point order, Palo Alto, USA, January 29.
- Character sums for primitive root densities, San Diego, USA, February 4.
- Getaltheorie als fysica, Amsterdam, The Netherlands, February 16.
- Efficient CM-algorithms, Singapore, March 26.
- On Artin's primitive root conjecture, Singapore, March 26.
- Primitive roots and arithmetic progressions, Leiden, The Netherlands, April 16.
- CM-algorithms in genus 1 and 2, Leuven, Belgium, May 18.
- Character sums for primitive root densities, Bonn, Germany, June 21.
- Elliptic curves, Bordeaux, France, July 15.
- Complex multiplication, Bordeaux, France, July 16.
- Elliptic curves and cryptography, Leiden, The Netherlands, October 8.
- Escher and the Droste effect, Den Haag, The Netherlands, November 6.
- Setting up an Erasmus Mundus master program, Paris, France, November 22

R. Tijdeman

- Applications of linear forms estimates by Cam Stewart, BIRS Centre, Banff, Canada, May 31.
- The effective research of Kálmán Győry, Debrecen, Hungary, October 4.

1.2 Arithmetic Geometry

S.J. Edixhoven
- Computational aspects of modular forms and Galois representations, Poznan, Poland, January 13.
- Using torsion points for computational purposes, Bordeaux, France, January 27.
- Computational aspects of 2-dimensional Galois representations, Essen, Germany, February 17.
- Galois representations and modular forms, Mainz, Germany, February 9-11.
- Two unrelated results on modular forms, Galois representations, and cubic curves, Leuven, Belgium, May 10.
- Toveren met getallen? Leiden, The Netherlands, June 20.
- Modular curves, their jacobians, modular parametrisations of elliptic curves, Bordeaux, France, July 15-18.
- Modular forms, cubic curves, and numerical analysis, Schiermonnikoog, The Netherlands, September 20-24.
- Snel en exact rekenen in getaltheorie door middel van benaderingen, KNAW, The Netherlands, October 25.
- Olsson's standard family and moduli problem, Leiden, The Netherlands, November 12.

R.S. de Jong
- Height of Ceresa cycles and Gross-Schoen cycles, Regensburg, Germany, February 25.
- Logarithmic equidistribution of division points on superelliptic curves, Paris, France, March 22.
- Resultant sequences for division polynomials, Nunspeet, The Netherlands, May 27.
- Computing values of Ramanujan's tau-function, Eindhoven, The Netherlands, September 15.
- Introduction to functorial compactification, Leiden, The Netherlands, September 17.
- Properness of Olsson's moduli problem, Amsterdam, The Netherlands, December 3.

J.P. Murre
- Lectures on Algebraic Cycles and Chow Groups, Trieste, Italy, June 21-30.

L.D.J. Taelman
- The Carlitz sheaf, cyclotomic function fields, and Vandiver’s conjecture, Londen, U.K., October 20.
- The Carlitz sheaf, cyclotomic function fields, and Vandiver's conjecture, Columbus, Ohio, U.S., November 16.

2.1 Analysis and Dynamical Systems

A. Doelman
- Blow-up in the complex Ginzburg-Landau equation, Leiden, The Netherlands, September 10.
- Complexiteit en Netwerken, Rotterdam, The Netherlands, November 10.

O.W. van Gaans
- Stochastic integration in Banach spaces for Levy processes, Nijmegen, The Netherlands, April 21.
- Periods of order-preserving nonexpansive maps on strictly convex normed spaces, Dresden, Germany, May 25.

S.C. Hille
- Reverse engineering of the gradient sensing system in Dictyostelium requires stochastic modeling, Eindhoven, The Netherlands, April 16.
- Reverse engineering of the auxin transport system in Arabidopsis plants, Utrecht, The Netherlands, April 23.
- Reverse engineering of the auxin transport system in Arabidopsis plants, Amsterdam, The Netherlands, October 6.

M.F.E. de Jeu
- Real Paley-Wiener theorems and local spectral radius formulas, Utrecht, The Netherlands, April 23.

B. Koren
- A new formulation of Kapila's five-equation model for compressible two-fluid flow, and its numerical treatment, Nice, France, July 8.
- A physical model and numerical method for compressible two-fluid flow, Luminy, France, July 22.

L.A. Peletier
- Dynamical Systems Methods for Analysing Turnover Models, Guildford, UK, January 25.
- Turnover Models, Physiological Limits and Target-Mediated Drug Disposition, Gothenburg, Sweden, February 8.
- Impact of protein and lipid binding on drug disposition, Pittsburgh, USA, July 12.
- The Dynamics of Protein Binding, Leiden, The Netherlands, September 8.
- Impact of protein and lipid binding on drug disposition, Amsterdam, The Netherlands, September 22.
- Dynamical Systems in Pharmaceutical Science, The Hague, The Netherlands, November 10.

V. Rottschäfer
- Singular solutions of the generalised Korteweg-de Vries equation, Amsterdam, The Netherlands, March 31.
- Singular solutions of the generalised Korteweg-de Vries equation, Eindhoven, The Netherlands, April 13-16.
- Amplitude equations for systems with a conservation law ,Barcelona, Spain, May 31-June 4.
- De uitdagende vraagstukken van bedrijven, Amsterdam, The Netherlands, August 27.

2.2 Probability Theory

M. Heydenreich
- Kritische Perkolation in hohen Dimensionen, Münster, Germany, January 14.
- Random walk on high-dimensional incipient infinite cluster, Amsterdam, The Netherlands, March 23.
- Random walk on high-dimensional incipient infinite cluster, Berlin, Germany, April 8.
- Mean-field behaviour in percolation, Amsterdam, The Netherlands, April 21.
- Random walk on (high-dimensional) incipient infinite cluster, Utrecht, The Netherlands, June 4.
- Properties of random walk on (high-dimensional) incipient infinite cluster, Sapporo, Japan, September 2.

W. Th.F. den Hollander
- Random walks in dynamic random environments, Erlangen, Germany, January 21.
- The mathematical work of Jurgen Gärtner, Berlin, Germany, April 8.
- Random walks in dynamic random environments, Nantes, France, June 7.
- Gibbs-non-Gibbs transitions under stochastic dynamics, Erlangen, Germany, June 17.
- Percolation, Nijmegen, The Netherlands, June 23.
- Random walks in dynamic random environments, Mainz, Germany, July 2.
- Random Polymers (6 lectures and 5 tutorials), Buzios, Brazil, August 2-7.
- A key large deviation principle for interacting stochastic systems, Hyderabad, India, August 22.
- Metastability and Potential Theory, Marseille, France, October 1.
- Random walks in dynamic random environments, Delft, The Netherlands, October 6.
- Variational approach to copolymers near linear interfaces, Berlin, Germany, October 14.
- On the collision local time of two transient random walks, Luminy, France, December 6.
- Random walks in dynamic random environments, Utrecht, The Netherlands, December 10.

E. Verbitskiy
- Homoclinic points in Algebraic Dynamics, Groningen, The Netherlands, February 15
- Modeling Glucose Evolution, NDNS+ symposium, Eindhoven, The Netherlands, April 14
- Preservation of Gibbsianity in d = 1, Groningen, The Netherlands, September 17.
- Thermodynamics of a binary symmetric channel, Warsaw, Poland October 14.
- Thermodynamics of a binary symmetric channel, Delft, The Netherlands, December 1.

2.3 Mathematical and Applied Statistics

R.D. Gill
- Learning from Lucia, Chia Laguna, Sardinia, May, 13.
- Learning from Lucia, Pireaus, Greece, August 28.
- Learning from Lucia, London, U,K,, November 10.
- Learning from Lucia, Warwich, U.K., November 11.
- Learning from Lucia, Bath, U.K., November 12.

P. Grünwald
- The Catch-Up Phenomenon in Model Selection and Model Averaging, Delft, the Netherlands, April 17.
- Statistiek in de Rechtzaal, Rotterdam, The Netherlands, November 4.
- The Catch-Up Phenomenon in Bayesian Inference, Leuven, Belgium, March 11.
- Statistics without Stochastics, Amsterdam, The Netherlands, September 8.
- Updating Probabilities and Characterizing CAR: when conditioning succeeds and when it fails, Groningen, the Netherlands, September 20.

J.J. Meulman
- Multidimensional analysis of metabolomic data, Dalian, China, October 12.
- SPSS Categories: Software for nonlinear multidimensional analysis, Leiden, The Netherlands, October 28.
- Clustering Objects on Subsets of Attributes in Liquid Chromatography – Mass Spectrometry Data. Amsterdam, The Netherlands, November 10.

W.R. van Zwet
- The birth of modern statistics, Nijmegen, The Netherlands, April 7.
- Beware of the bootstrap, Seattle, USA, July 29.
- Remembering Erich Lehmann, Gothenburg, Sweden, August 13.

3 Mathematics, Computer Science and Society

F.A.J. Birrer

- The virtual world of policy arguments: the case of the Electronic Health Record, Amsterdam, The Netherlands, June 30

Memberships of editorial boards

R. Cramer
- IACR Journal of Cryptology
- Information Security and Cryptology Book Series: advisory board
- Journal of Mathematical Cryptology
- Computer Security Center, advisory Board
- Program Committee Member 8th Annual IACR TCC

G. van Dijk
- Vestnik Tambov University

A. Doelman
- Physica D (Nonlinear Phenoma) (Editor-in-Chief)
- Journal of Computational Science

S.J. Edixhoven
- Compositio Mathematica (managing editor)
- Journal of Number Theory
- Expositiones Mathematicae

J.H. Evertse
- Compositio Mathematica

R.D. Gill
- Cambridge University Press Series in Statistical and Probabilistic Mathematics
- Annals of Statistics
- Methods of Mathematical Statistics
- Probability and Mathematical Statistics
- Electronic Journal of Statistics
- International Statistical Review

P. Haccou
- Environmental modeling and assessment

W.Th.F. den Hollander
- Markov Processes and Related Fields
- Indagationes Mathematicae

B. Koren
- Journal of Computational Physics
- Mathematics and Computers in Simulation

H.W. Lenstra
- Algebra and number theory
- Foundations of Computational Mathematics
- Glasgow Mathematical Journal
- Journal of the European Mathematical Society

J.J. Meulman
- Journal of Classification

- British Journal of Mathematical and Statistical Psychology
- Springer Series *Studies in classification, data analysis, and knowledge organization*

J.P. Murre
- Indagationes Mathematicae

L.A. Peletier
- Advances in Differential Equations
- Differential and Integral Equations
- Journal of the European Mathematical Society
- Progress in Nonlinear Differential Equations and their Applications
- Indagationes Mathematicae

M.N. Spijker
- Journal of Computational and Applied Mathematics
- International Journal of Engineering
- Applicationes Mathematicae

P. Stevenhagen
- Contributions to Discrete Mathematics

L.D.J. Taelman
- Journal of Number Theory.

R. Tijdeman
- Acta Arithmetica
- Indagationes Mathematicae

E. Verbitskiy
- Journal of Mathematics-for-Industry, Japan

S.M. Verduyn Lunel
- Archiv der Mathematik
- Functional Differential Equations
- Integral Equations and Operator Theory
- Operator Theory Advances and Applications (series of monographs, Birkhäuser)

Honors

F. Bakker
- Benoeming tot Ridder in de Orde van Oranje-Nassau

G. van Dijk
- Silver Medal Koninklijke Hollandsche Maatschappij der Wetenschappen, Optime Meritis

R.D. Gill
- Distinguished Lorentz Fellow at NIAS (Netherlands Institute for Advanced Studies in the Humanities and Social Sciences), during the academic year 2010-2011

P. Grünwald
- Van Dantzig Prize (highest Dutch award in statistics and operational research)

Foreign visitors

The following data are given:
name, place and country of the visitor,
name(s) of the host(s)

1. Number theory, Algebra and Geometry

1.1 Number theory and Algebra
A. Bérczes and K. Győry, Debrecen, Hungary, J.-H. Evertse
A. Lucchini, Verona, Italy, H.W. Lenstra
M. Bhargava, Princeton, USA, H.W. Lenstra
T. Chinburg, Philadelphia, U.S.A., H.W. Lenstra
A.Lbekkouri, Casablanca, Morocco, H.W. Lenstra en B. de Smit
T. Shioda, Tokyo, Japan, R.M. van Luijk
B. Hanzon, Cork, Ireland, B. de Smit
D. Kohel, Marseille, France, P. Stevenhagen
L. Hajdu, Debrecen, Hungary, R. Tijdeman
N. Saradha, Mumbai, India, R. Tijdeman
T.A. Schmidt, Corvallis, Oregon, USA, R. Tijdeman
P. Zimmerman, Nancy, France, R. Tijdeman

1.2 Arithmetic Geometry
H. Hivert, Rennes, France, S.J. Edixhoven
Ch. Perrin, France, S.J. Edixhoven
J. Sauzeau, Rennes, France, S.J. Edixhoven
P.Parent, Bordeaux, France, S.J. Edixhoven
F. Andreatta, Milano, Italy, S.J. Edixhoven
S. Arias de Reyna, Essen, Germany, L.D.J. Taelman
J. Nicaise, Leuven, Belgium, L.D.J. Taelman

2. Analysis and Stochastics

2.1. Analysis and Dynamical Systems
V.F. Molchanov, Tambov, Russia, G. van Dijk
M. Wakayama, Fukuoka, Japan, G. van Dijk
K. Promislow, East Lansing, USA, A. Doelman
M. Riedle, Manchester, United Kingdom, O.W. van Gaans
A. Rusinek, Warsaw, Poland, O.W. van Gaans
A. Kalauch, Dresden, Germany, O.W. van Gaans
B. Lemmens, Canterbury, United Kingdom, O.W. van Gaans
M.C. Serra, Braga, Portugal, P. Haccou
B. Lu, Shanghai, China, P. Haccou
Th. Szarek, Gdansk, Poland, S.C. Hille.
J. Tomiyama, Tokyo, Japan, M.F.E. de Jeu

2.2. Probability Theory

M. Birkner, Mainz,Germany, W.Th.F. den Hollander
E. Bolthausen, Zürich, Switzerland, W.Th.F. den Hollander
M. van den Berg, Bristol, UK, W.Th.F. den Hollander
F. Comets, Paris, France, W.Th.F. den Hollander
A. Greven, Erlangen, Germany, W.Th.F. den Hollander
M. Hilario, Rio de Janeiro, Brazil, W.Th.F. den Hollander
G. Maillard, Marseille, France, W.Th.F. den Hollander
N. Pétrélis, Nantes, France, W.Th.F. den Hollander

2.3. Mathematical and Applied Statistics

B. Efron, Stanford, USA, R.D. Gill and J.J. Meulman
G. Lubke, Notre Dame, USA, J.J. Meulman
R. Cowell, London, UK, R.D. Gill
J. Mortera, Rome, Italy, R.D. Gill
S. Lauritzen, Oxford, UK, R.D. Gill
Y. Nishiyama, Tokyo, Japan, R.D. Gill
D. Anevski, Lund, Sweden, R.D. Gill

Research Staff

1. Number theory, Algebra and Geometry

1.1 Number theory and Algebra

permanent staff:
prof.dr. R.J.F. Cramer
dr. J.-H. Evertse
prof.dr. H.W. Lenstra
dr. R.M. van Luijk
dr. B. de Smit
prof.dr. P. Stevenhagen

emeritus:
prof.dr. R. Tijdeman

postdocs:
dr. D.C. Gijswijt
dr. E.W. Kiltz (from March till September 1)
dr. K. Pietrzak (till April 1)
dr. C. Salgado Guimaraes de Silva

PhD students:
A. Angelakis , MSc (from September 1).
drs. J. Bouw
J. Brau, MSc. (from September 1)
drs. J.L.A.H. Daems
B.E. van Dalen, MSc.
H.D. Duong, MSc. (from September 1)
drs. W.H. Ekkelkamp (till February 1)
A. Gioia, MSc. (from September 1)
drs. B.J.H. Jansen
M.F. Kosters, MSc. (from September 1)
drs. R. Pannnekoek
Ir. I. Smeets (till June 1)
drs. T.C. Streng (till June 1)
G. Dalla Torre, MSc (from September 1)
E.L. Toreao Dassen, MSc.
C Zhang (from September 1)

guest researcher:
drs. H.M. Matthijsse (LIO)
dr. F. Najman (from September 1)

1.2 Arithmetic Geometry

permanent staff:
prof.dr. S.J. Edixhoven

dr. R.S. de Jong
dr. M. Lübke
dr. L.D.J. Taelman (from July 1)

emeriti:
prof.dr. J.P. Murre
prof.dr. A.J.H.M. van de Ven

PhD students:
S. Anni, MSc. (from September 1)
drs. P.J. Bruin (till September 1)
drs. A. Javanpeykar (from September 1)
drs. A.P. Stolk
drs. C. Zhang (from September 1)

2. Analysis and Stochastics

2.1 Analysis and Dynamical Systems

permanent staff:
prof.dr. A. Doelman
dr. O.W. van Gaans
dr. S.C. Hille
dr. M.F.E. de Jeu
prof.dr.ir. B. Koren
dr. J.D.M. Rademacher
dr. V. Rottschäfer
prof.dr. S.M. Verduyn Lunel

emeriti:
prof.dr. G. van Dijk
prof.dr.ir. L.A. Peletier
prof.dr. M.N. Spijker

postdocs
dr. P. Haccou (till July 1)
dr. L. Sella

PhD students:
T.S.O. Alkurdi, MSc.
Ir. G.N.J.C. Bierkens (till February 1)
G. Chen, MSc.
W.R. Fortes
H.J.M. Messerschmidt, MSc.
M. Muskulus, Dipl.Math. (till February 1)
drs. M. van der Schans
I. Stojkovic, MSc.
V. Timperio, MSc.
F.W.J. Veerman, MSc

drs. D. Worm (till October 1)
M. Wortel, MSc.

guest researcher:
prof.dr. H. Metz (till July 1)

2.2 Probability Theory

permanent staff:
dr. M. Heydenreich (from September 16)(STAR cluster)
prof.dr. W.Th.F. den Hollander
prof.dr. V. Sidoravicius
dr. F.M. Spieksma
prof.dr. E. Verbitskiy (from February 1)

Emeritus:
prof.dr. A. Hordijk
prof.dr. L.C.M. Kallenberg (from January 1)

postdoc:
dr. A. Opoku

PhD students:
drs. L. Avena (till November 1)
J.F. Martinez, MSc (from September 1)
R. Soares dos Santos, MSc.
A. Troiani, MSc.
drs. K. Vafayi
F.M. Völlering, Dipl. Math.
F. Wang, MSc.

guest researcher:
prof. dr. M. Keane
prof. dr. F. Redig

2.3 Mathematical and Applied Statistics

permanent staff:
prof.dr. R.D. Gill
prof.dr. P.D. Grünwald
prof.dr. J.J. Meulman
dr. H.G.J. van Mil (from March 1)

emeritus:
prof.dr. W.R. van Zwet

PhD students:
drs. S. Zohren

guest researcher:
prof.dr. A.W. van der Vaart

3. Mathematics, Computer Science and Society

permanent staff:
drs. F.A.J. Birrer

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dr. M. Lübke (from February 1)

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T.A. Dijks

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dr. R.J. Kooman

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M.F. Feleus (till July 1)
M. Vijn (till July 1)

secretariat:
T.H. Bakker-Bouma

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education:

Y. Achnine		
T.P.F. Blankevoort		(from September 1)
J.A. Boon	(till July1)	
W.P.S. Cames van Batenburg		(from September 1)
H.P. Chang	(till July 1)	
X. Cheng	(till September 1)	
R. van Dobben de Bruyn		(from September 1)
R.H. Eggermont		
W. Ellens		
T.E. Feenstra		
M.M.W. Fung		
A.G. Hauwert	(till July 1)	
F. van Helden	(till July 1)	
R.W. Hoogwater		(from September 1)
A. Javanpeykar		(from September 1)
J. Jin		
A.K.A. Kalsbeek	(till July 1)	
Y. Kiliç	(till July 1)	
M. Kosters	(till July 1)	
S.A. van Lieshout	(till July 1)	
M.A. Lopuhaä		(from September 1)
E. Massop		(from September 1)
J. Michielsen	(till July 1)	
A. Moritz		(from September 1)
F.H.S. Offergelt		(from September1)
F.P.R. Olsthoorn		(from September 1)
T. van Ommen	(till July 1)	
B.C.F. Opheusden		
S.L. van der Pas		
S. Ramawadh	(till July 1)	
B. de Rijk		(from September 1)
M. Roelands		(from September 1)
J. Rozendaal		(from September 1)
D.D. Sierag		(from September 1)
S. van der Sluis		(from September 1)
W. Subramanian		(from September 1)
R.M.J. Vooys		
J. van Wamelen	(till July 1)	
W. Zomervrucht		

tutoren:

M. Assendorp		
R. van Bommel		(from November 1)
N. uit de Bos		(from November 1)
F. Claassens		(from November 1)
T. Groen		(from November 1)
M. Lopuhaä	(till July 1)	
E. Massop	(till July 1)	
St. Pouwelse	(till July 1)	
E. Visse	(till July 1)	
M. Warrens		(from November 1)

webmaster:

F.W. van Rest

pr:

F. Offergelt	(till July 1)
B. de Rijk	(till July 1)
R. Winter	(till July 1)

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