

# EURANDOM

Report 2009

**European Institute for  
Statistics, Probability, Stochastic Operations Research and their Applications**  
Location: Eindhoven University of Technology  
P.O. Box 513, 5600 MB Eindhoven, The Netherlands  
Telephone: +31 (0)40 247 8100, Telefax: +31 (0)40 247 8190  
E-mail: [office@eurandom.tue.nl](mailto:office@eurandom.tue.nl)  
<http://www.eurandom.tue.nl>

## **New People in 2009**

### **MRM**

Florence Guillaume  
Mitja Stadje

### **QPA**

Yoni Nazarathy  
Michel Jansen

### **RSS**

Anton Klymovskiy  
Sandra Kliem  
Sander Dommers  
Tim Hulshof

### **SIM**

Paulo de Andrade Serra  
Bartek Knapik

### **NiMH**

Alexander Ledovskikh

## **People who left in 2009**

### **MRM**

### **QPA**

Ahmad Al Hanbali (November 30) -> *assistant professor University Twente, The Netherlands, Academia*  
Paul Beekhuizen, -> *Robeco Quantative Strategies, The Netherlands, Industry*  
Brian Fralix, -> *assistant professor Clemson University, USA, Academia*  
Yoav Kerner (February), -> *postdoc Technion Haifa, Israel, Academia*  
Ingrid Vliegen, -> *assistant professor University Twente, The Netherlands, Academia*

### **RSS**

Dimitris Cheliotis, -> *assistant professor University of Athens, Greece, Academia*

### **SIM**

Efang Kong, -> *lecturer University of Kent, United Kingdom, Academia*  
Shota Gugushvili (December 31) -> *postdoc Vrije Universiteit Amsterdam, The Netherlands, Academia*

### **ĪBAT**

Alexander Ledovskikh, -> *postdoc TU/e, The Netherlands, Academia*

**Out of 9 postdocs and PhD students who left EURANDOM, 5 got a position as assistant professor or lecturer at a university in the Netherlands (2) or abroad (3), one got a position in the financial industry in the Netherlands and 3 started another postdoc position in the Netherlands (2) or abroad (1).**

## People

### Board

- Prof.dr. F.A. van der Duyn Schouten (Chair/treasurer)
- Prof.dr.ir. C.J. van Duijn (member)
- Prof.dr.ir. G. van Oortmerssen

### Scientific Council

- Professor S. Asmussen (Aarhus University, Sweden) (until July 2009)
- Professor J. Beirlant (KU Leuven, Belgium)
- Professor S. Borst (Eindhoven University of Technology and Lucent, Murray Hill, USA)
- Professor D. Dawson - Chair (Carleton University, Ottawa & McGill University, Montreal, Canada)
- Professor F. Delbaen (Eidgenössische Technische Hochschule Zürich, Switzerland) (until July 2009)
- Professor A. Frigessi (University of Oslo, Norway)
- Professor P. Green (University of Bristol, United Kingdom) (until July 2009)
- Professor A. Greven (Friedrich-Alexander Universität, Erlangen-Nürnberg, Germany)
- Professor P. Hall (Australian National University, Canberra, Australia) (until July 2009)
- Professor Ph. Robert (Centre de Recherche INRIA Paris-Rocquencourt)
- Professor A. Schied (Mannheim University, Germany) (from July 2009)
- Professor V. Schmidt (Ulm University, Germany)
- Professor D. Silvestrov (Mälardalen University, Sweden) (from July 2009)
- Professor V. Sidoravicius (CWI, Leiden University, The Netherlands)
- Professor A.W. van der Vaart (Vrije Universiteit Amsterdam, The Netherlands)
- Professor N. Veraverbeke (Hasselt University, Diepenbeek, Belgium)
- Professor T. de Wet (University of Stellenbosch, South Africa) (from July 2009)

The scientific council of EURANDOM met on December 14, 2009.

### Directors

Prof.dr.ir. O.J. Boxma (Eindhoven University of Technology & EURANDOM), scientific director  
Drs. C.M.M. Cantrijn, managing director

### Scientific staff

#### Senior Fellows

##### Multivariate Risk Modelling

Dr. R.J.A. Laeven (Tilburg University)  
Professor W. Schoutens (KU Leuven, Belgium)  
Professor J. Teugels (KU Leuven, Belgium)

##### Queueing and Performance Analysis (QPA)

Professor I.J.B.F. Adan (Eindhoven University of Technology)  
Professor R.J. Boucherie (University of Twente)  
Dr. N.P. Dellaert (Eindhoven University of Technology) until end of 2009  
Professor G.J.A.N. van Houtum (Eindhoven University of Technology)  
Professor M.R.H. Mandjes (CWI & University of Amsterdam)  
Professor A.P. Zwart (CWI)

##### Random Spatial Structures (RSS)

Professor R.W. van der Hofstad (Eindhoven University of Technology)  
Professor W.Th.F. den Hollander (Leiden University)  
Professor V. Sidoravicius (CWI / Leiden University)

##### Statistical Information and Modelling (SIM)

Dr. E. Belitser (University Utrecht) from September 2009  
Professor P.L. Davies (Eindhoven University of Technology & Universität Duisburg-Essen, Germany), until April 2009  
Professor M.C.M. de Gunst (VU University, Amsterdam)  
Professor G. Jongbloed (Delft Technical University)

Professor C.A.J. Klaassen (University of Amsterdam)  
Professor J.H. van Zanten (Eindhoven University of Technology) from 1 September 2009

In addition to these programmes one project is running since the beginning of 2006:

**Integrated Batteries (i-BAT)**

The research is guided by professor P.H.L. Notten (Philips Research Laboratories, TU/e, Eindhoven, The Netherlands).

**Junior staff**

The junior scientific staff of EURANDOM consists of Postdocs (PDs) with appointments from 6 months up to 2-3 years; PhD-students (PhDs) with appointments of 4 years and research fellows with part-time 1-year appointments.

**Scientific Staff**

On December 31, 2009, 30 researchers (PDs and PhDs) were working at EURANDOM.

**Multivariate Risk Modelling**

**PDs**

Henrik Jönsson  
Mitja Stadjc (since July 7)

**PhDs**

Florence Guillaume (since October)

**Queueing and Performance Analysis**

**PDs**

Ahmad Al Hanbali (until November 30)  
Brian Fralix (until February 28)  
Yoav Kerner (until July 31)  
Liqiang Liu  
Andreas Löpker  
Yoni Nazarathy (since March 1)  
Seva Shneer

**PhDs**

Paul Beekhuizen  
Remco Bierbooms  
Marko Boon  
Josine Bruin  
Çağdas Büyükkaramikli  
Jevgenijs Ivanovs  
Michiel Jansen (since August 1)  
Kamil Kosinski  
Ingrid Reijnen-Koens  
Peter van de Ven  
Ingrid Vliegen (until October 31)  
Sandra van Wijk

**Research Fellows**

Bernd Heidergott (VU University, Amsterdam)  
Johan van Leeuwaarden (Eindhoven University of Technology)  
Maria Vlasiou (Eindhoven University of Technology)

**Random Spatial Structures**

**PDs**

Dimitris Cheliotis (until September 17)  
Sandra Kliem (since October 1)  
Anton Klymovskiy (since December 1)  
Artem Sapozhnikov  
Lihu Xu

**PhDs**

Robert Fitzner  
Sander Dommers (since March 1)  
Tim Hulshof (since April 1)

**Research Fellows**

Cristian Giardinà (Eindhoven University of Technology)  
Francesca Nardi (Eindhoven University of Technology)  
Wouter Kager (Vrije Universiteit) (until December 31)

**Statistical Information and Modelling****PDs**

Shota Gugushvili (until December 31)  
Efang Kong (until January 31)  
Mikhail Langovoy (since October 1)

**PhDs**

Paulo de Andrade Serra (since August 15)  
Bartek Knapik (since October 6)

**Research Fellows**

Olaf Wittich (Eindhoven University of Technology) (since June)

**ABAT****PD**

Alexander Ledovskikh

**Funding**

During the year 24 junior researchers were (co-)financed by external funds, from which:

**In natura (11):**

1 PhD on a Philips contract (Beekhuizen)  
1 PhD out of NWO-VICI grant Professor R.W. van der Hofstad, part time 0,6 (Dommers)  
1 PhD out of NWO Free Competition grant Remco van der Hofstad, part-time 0,2 (Hulshof)  
5 PhDs of the Department of Mathematics and Computer Science, part-time 0,2 à 0,6 (Boon, Fitzner, Van de Ven, Van Wijk, Bierbooms)  
4 PhDs of the Department of Industrial Engineering & Innovation Sciences, part-time 0,2 (Vliegen, Reijnen, Büyükkaramikli, Jansen)  
1 PhD from the VU, through Van Zanten (TU/e), part-time (0,2) (Knapik)

**Grants (7):**

1 PD on a 3-years EIB grant (Jönsson)  
1 PD on an NWO OC grant since December 2008; part of a 3-year grant together with CWI and Twente University (Al Hanbali)  
1 PD on a 3-years industry grant (Falcon) (Liu)  
1 PhD on a VC grant since October 2008, jointly employed with UvA (Kosinski)  
2,4 PD positions on the extended NWO-BRG grant (spread over 5 persons, out of which 2,5 still present in 2009)  
1 PD until May on a Philips-EET contract, then postdoc on a Senter Novem Project NiMH (Ledovskikh)

**Joint appointments (6):**

Joint appointment with University of Amsterdam: 1 PhD (Ivanovs)  
Joint appointment with Eindhoven University, M&CS: 1 PhD à 0,5 (Bruin); 2 PDs à 0,3 each (Shneer, Löpker)  
Joint appointment with University of Utrecht, 1 PhD (Serra)  
Joint appointment with Eindhoven University of Technology, ME (out of VIDI grant of dr. E Lefebber): 0,5 PD (Nazarathy)

**Administrative Support:**

Mrs. M.E.J.G.H. (Marlies) Brangers - management assistant (0,9 fte)

Mrs. L. (Lucienne) Coolen-van Will - workshop officer (0,9 fte)

Drs. J.J. (Jonelleke) Kamperman - personnel officer and policy assistance (0,8 fte) until April 1

Mrs. P.M. (Patty) Koorn - administrative officer (0,5 fte)

*During 2009, 35 reseachers worked at EURANDOM. A total of 18 fte was employed by Eindhoven University of Technology, EURANDOM, including the managing director and the support staff, not included the scientific director and senior fellows. Furthermore, EURANDOM contributed to two appointments elsewhere (Shneer, Löpker).*

*In addition 18 senior scientists were associated with EURANDOM as senior fellow and 7 junior scientists were associated as research fellow.*

*In 2009 11 researchers started to work at EURANDOM, 9 researchers left EURANDOM.*

## RESEARCH PROGRAMMES

### Multivariate Risk Modelling (MRM)

#### Florence Guillaume

Together with Prof. Wim Schoutens, Florence Guillaume has worked on the comparison of the Delta-hedging strategy under the Black-Scholes model and under a particular VG space volatility model, the so-called standard VG space model. This model is obtained by replacing the standard Normal distribution by the symmetric VG distribution with a parameter  $\nu$  equal to 1. In particular, we focus on the performance of the P&L of liquid vanilla options written on two major indices quoted on the US market: the Dow Jones and the S&P500. In a first time we look at the optimal historical VG space model by considering one of the most straightforward simple risk measures: the P&L variance. We then compare the P&L variance evolution through time under the Black-Scholes model and the standard VG space model for options traded on a monthly basis from the 4th of January 1999 on. Finally, we compare different performance measures and acceptability indices for the P&L of liquid in-the-money vanilla options, i.e. for writing the option, hedging the position on a daily basis and paying out the option payoff at maturity, focusing therefore on the typical hedging strategy adopted by financial institutions.

#### Henrik Jönsson

Dr. Jönsson has since July 2008 worked on the "Quantitative analysis and analytical methods to price securitization deals" project sponsored by European Investment Bank. Together with prof. Wim Schoutens and Geert van Damme (KU Leuven) a first paper has been finalized and the paper has been published in Radon Series on Computational and Applied Mathematics, Volume 8, 2009. During the period May 2009 to October 2009 Henrik Jönsson worked on a large report on asset backed securities (ABSs), covering the fundamentals of risks in and the rating of ABSs. The report also contains a large collection of mathematical models that can be applied to the valuation of ABSs and a numerical study is presented which analyzes the model risk and the parameter sensitivity of the rating of ABSs. During the project Henrik Jönsson is developing a prototype tool in MATLAB that can be used for assessing ABSs. During the end of 2009 a real asset backed securities deal is planned to be tested in the tool. Henrik has, together with Wim Schoutens, Guido Bichisao (EIB) and Karsten Sundermann (EIB), been organizing a two day conference on asset backed securities held at EIB in Luxembourg on 29-30 October. Together with professor Wim Schoutens (KU Leuven, Belgium), professor Cornelis Oosterlee (TU Delft) and Fang Fang (TU Delft) Dr. Henrik Jönsson has been working on a paper on pricing of single name credit derivatives using Lévy models. The paper was finalized and submitted early 2009 to the Journal of Computational Finance and is now conditionally accepted and is under revision by the authors.

#### Mitja Stadje

Together with Roger Laeven, Stadje has written a paper on choice under risk and ambiguity, which is almost complete. He is also working with Roger Laeven on another paper where we characterize the loss functionals from Microeconomic Theory which are convex risk measures. It turns out that this class is obtained by replacing the expectation with a more robust operator which also has a sound interpretation from Microeconomic Theory.

Moreover, he has started to work on a project which Wim Schoutens gave him. They aim to model the dependence structure of different Multivariate Variance Gamma models with copulas.

#### Workshops and conferences

In 2009 MRM organized 1 workshop.

#### Lectures and Seminars

In 2009 MRM organized 3 lectures and seminars.

#### EURANDOM visitors

In 2009 MRM hosted 2 visitors; altogether for 6,4 weeks.

## Queueing and Performance Analysis (QPA)

### Ahmad Al Hanbali

We developed a general framework to analyze polling systems with either the autonomous-server or the time-limited service discipline. We consider Poisson batch arrivals and phase-type service times. It is known that these disciplines do not satisfy the well-known branching property in polling system. Therefore, hardly any exact results exist in the literature. Our strategy is to apply an iterative scheme that is based on relating in closed-form the joint queue-length at the beginning and the end of a server visit to a queue. These kernel relations are derived using the theory of absorbing Markov chains. We study the transient behavior of a state dependent M/M/1/K queue during the busy period. We derive in closed-form the joint transform of the length of the busy period, the number of customers served during the busy period, and the number of losses during the busy period. We differentiate between two types of losses: the overflow losses that are due to a full queue and the losses due to the admission controller. For two special cases called the threshold policy and the static policy we determine simple expressions for their joint transform. Currently, extending these results for PH/PH/1/K queues that include special cases like M/PH/1/K and PH/M/1/K queues.

### Paul Beekhuizen

Performance analysis of networks on chips.

Networks on Chips (NoC) constitute an emerging paradigm for on-chip communication. NoCs are composed of a number of hardware elements (routers, links, network interfaces) that are connected to form a network, plus a set of rules (a communication protocol) that specify how the packets are routed through the network. To be economically viable, a NoC must be implemented on a very small area of the chip and must satisfy stringent cost constraints. This leads to a number of distinguishing features:

- (a) The queueing elements are switches with small buffers, suffering from Head-of-Line blocking;
- (b) The predominant routing mechanism is worm hole routing;
- (c) Flow control is used to limit the number of packets in the network and to avoid overflow at the receiver.

These features give rise to challenging performance analysis questions that will be studied in a joint project of EURANDOM and Philips Research.

### Remco Bierbooms

Together with Ivo Adan (TU/e) and Marcel van Vuuren (CQM), Remco Bierbooms has been working on tandem production lines, both for discrete and continuous materials. The goal is to obtain a good estimation for the throughput and total sojourn time.

For production lines with discrete products, they improved an existing method by Ivo Adan and Marcel van Vuuren by including dependence in successive service times. The new method gives better results for longer tandem lines and for high variance in service times. In general, the new method is more stable in the input parameters.

For production lines with continuous material (i.e. fluid) they are building a completely new model, using decomposition and iteration. The challenge is to model starvation and blocking in the production line, which is done by modelling the behavior of each machine as a Markov chain. Results for machines with exponential up- and downtimes look promising, the step towards general type up- and downtime distributions will now be made.

### Marko Boon

In 2009, Marko Boon has continued working on polling models under the supervision of Onno Boxma and Ivo Adan. They have studied some model variants, including reneging and varying arrival rates. Furthermore, together with Sandra van Wijk and Erik Winands, they have developed a closed-form approximation for the mean waiting times in polling systems.

### Josine Bruin

Together with Jan van der Wal we looked at the possibility to construct a dynamic production strategy for a multi-item production system with multiple machines instead of just one. Using a similar approach as the one step improvement approach used for the single machine multi-item production system, we obtained a dynamic strategy for a system with two machines and lost sales. Further, we obtained nice results for the one step improvement approach for the system with one machine and backlog.



Together with Onno Boxma and Brian Fralix, we looked at the waiting times in polling systems with various service disciplines and we obtained some results in the form of Laplace-Stieltjes transforms.

#### **Cağdas Büyükkaramikli**

Together with Ivo Adan, Cağdas Büyükkaramikli has been investigating the distribution and the moments of the sojourn time of a queue, which starts serving at a higher rate after a certain number of customers are accumulated in the system. They also try to extend their results when the update of the capacity (i.e. server rate) increase can be only achieved at certain points where the times between two consecutive points are exponentially distributed. Together with Bernardo D'Auria (Universidad Carlos III de Madrid), they will work on further expansions of this model (i.e. when the time between two points is Erlang distributed).

#### **Jevgenijs Ivanovs**

My research mostly concerns fluctuations of Markov additive processes (MAP). This year we (Bernardo D'Auria, Offer Kella and Michel Mandjes) submitted two papers on this topic, where the first passage process of a spectrally-negative MAP is fully characterized.

Together with Z. Palmowski we have been investigating the first passage of a reflected MAP.

#### **Michiel Jansen**

The coordination of material flows in a multi-item, multi-echelon supply chain network is a difficult problem. It becomes even more difficult if the transforming entities in the network (that we call production units) exhibit complex behavior dependent on capacities, and the level and composition of the workload. A hierarchical approach of the problem is inevitable. The anticipation function (cf. Schneeweiss) has an important role in hierarchical decision making. It is the description of a base level behavior at the top level. In my research, I am studying the production unit (base level) anticipation function for centralized supply chain operations planning (top level).

#### **Kamil Kosinski**

Together with Onno Boxma, Jevgenijs Ivanovs and Michel Mandjes we have been working on the Lévy-driven polling models. We have been able to identify a branching structure in such models, which allowed us to obtain the steady-state workload distribution at polling instants and arbitrary instants in a cycle. Furthermore, he has been working with Krzysztof Debicki, Michel Mandjes and Tomasz Rolski on the asymptotics of the probability of simultaneous high extrema of an arbitrary number of Gaussian processes. We have already been able to generalize and extend some known results for the 2-dimensional case. Finally, in September 2009, Kosinski started working with Onno Boxma on the heavy-traffic analysis for Lévy-driven queues. This work should extend the results known for the M/G/1 queue.

#### **Andreas Löpker**

I'm interested in Markov Process, in particular in Piecewise Deterministic Markov Processes. I study the stability of these processes, hitting times, distributional properties and questions that have relevance to applied models.

Further I study on questions regarding the modelling of the TCP window size process by PDMPs (with Johan van Leeuwen). Currently a new project has been planned together with David Goldberg and Teunis Ott regarding a discussion of the unstable cases for the process discussed in "TCP and Iso-stationary transformations".

#### **Liqiang Liu**

In the FALCON project I focus on using queueing network models to evaluate performance of conceptual design of picking systems. The compact picking system (CPS) is taken as a study case. A seemingly paradigm adopted by Vanderlande is to place the conveyor system in the spot light. Then choices of type and number of pick stations and miniloads are made to generate suitable traffics on the conveyor for it to run on the "sweet spot": enough to achieve desired throughput; not too much to induce excessive congestion. Of course it is desirable that the capacity of every component is fully utilized. On the other hand, it is reasonable to reserve "safety margins" due to the stochastic nature of the operations. Based on these considerations, we aim at developing fast screening tools for a large number of possible configurations.

A simplified queueing network model for CPS has been proposed previously. The model involves complicating features (namely multi-class, greedy bulk service rule) in contrast to the conversional "easy-to-analyze" model. For efficient (possibly approximate) evaluation of the network, a plausible strategy is

to divide-and-conquer. I develop the sequential aggregation method following this strategy. Based on extensive testing cases, both speed and accuracy of the method are satisfactory.

For knowledge dissemination, I demonstrate Vanderlande a computer program that facilitates decision makings in sales and early design phase. I explain the general methodology, case-specific details and report our findings in meetings, seminars and conferences.

Other relevant FALCON project activities include discussions, experiments and analysis of real data to

- 1) have a better understanding of the CPS;
- 2) identify secondary details that are simplified in the current model;
- 3) extend the current model to incorporate (partially) secondary details;
- 4) consider other type of picking systems.

Also an intriguing question on formalizing nearly decomposable property of queueing network is proposed in an open problem session of the STAR seminars.

Besides the FALCON project, another main research theme is application of theory in piecewise deterministic Markov process (PDMP). In particular, I work with David Perry and Ivo Adan on perishable inventory systems. I found a unified approach which is directly amenable to numerical computations within the PDMP framework. Moreover, the approach covers a wide range of applications of stochastic models, e.g. queueing models with workload-dependent balking, which have been arising from stochastic operational research in call centers and health care areas. Some results on this research are presented in "Finite Buffer Fluid Models with Overflow Protection: Applications in Queueing Models" San Diego, CA, USA; 11/10-14/10; "INFORMS Annual Meeting, 2009"; <http://meetings2.informs.org/SanDiego09/index.php>

#### **Yoni Nazarathy**

Together with Ahmad Al-Hanbali, Michel Mandjes (UvA) and Ward Whitt (Columbia University), Yoni Nazarathy has been investigating the asymptotic variance of outputs of critically loaded queueing systems. Some surprising results were obtained. Further, jointly working with Dr. Erjen Lefebber from the Mechanical Engineering Department, Yoni is investigating stability of controlled manufacturing systems with switching servers. A third collaboration is with Dr. Oded Raz of the Electrical Engineering Department. Here Yoni is investigating the performance analysis of optical packet switched networks.

#### **Ingrid Reijnen**

Ingrid Reijnen's interest is in the area of planning and design of spare part networks. Especially networks where lateral transshipments are (partially) allowed between warehouses. We focus on continuous time models and use various techniques, such as results from Queueing models, to analyse the networks.

#### **Seva Shneer**

Together with V. Wachtel (University of Munich) V. Shneer studied the behaviour of the maximum of a random walk with a small negative drift. They provided a unified approach to obtain heavy-traffic limits for all random walks from the domain of attraction of a stable law.

H. Jönsson, O. Boxma, J. Resing and V. Shneer investigated ruin probabilities of an alternating risk reserve process under two different policies.

Together with M. Jonckheere, V. Shneer was looking at birth-and-death processes where birth and death rates are given by arbitrary 0-homogeneous functions. These processes appear often when the evolution of a communication network is described. M. Jonckheere and V. Shneer derived various computable criteria for stability and instability of such processes in any dimension and for processes with piece-wise constant drifts in dimension 2, together with generic sufficient conditions for processes with discontinuous drifts in any dimension.

P. van de Ven and V. Shneer are studying various performance characteristics of the classical CSMA algorithm and its slotted counterpart governing the behaviour of a mesh network of  $n$  nodes on a straight line. They compare the achieved throughputs and fairness.

#### **Peter van de Ven**

Together with Guido Jansen and Johan van Leeuwen, Peter van de Ven studied the impact of the blocking range in the CSMA-based tandem network, in the presence of collisions. The aim is to optimize the throughput as a function of the blocking range.

Together with Seva Shneer, Peter examined a tandem network consisting of  $n$  nodes, with a  $k$ -hop blocking model, and used this setting to compare slotted CSMA and non-slotted CSMA. Finally, he fi-

nished his work on fairness in CSMA tandem networks. This is joint work with Sem Borst, Dee Dente-  
neer, Johan van Leeuwen and Seva Shneer.

#### **Ingrid Vliegen**

My research mostly focuses on the capital goods industry, more specifically on inventory models for  
spare parts.

Methodologies that I use in this research: queueing theory, stochastic processes, simulation and empiri-  
cal studies.

#### **Sandra van Wijk**

Pooling of resources in queueing models and inventory systems; Polling models.

#### **Workshops and conferences**

In 2009 QPA organized 5 workshops.

#### **Lectures and Seminars**

In 2009 QPA organized 30 lectures and seminars (QPA- regular seminar, QPA Reading Seminar and QPA  
Problem Session).

#### **EURANDOM visitors**

In 2009 QPA hosted 21 visitors; altogether for 106 weeks.

## Random Spatial Structures (RSS)

### Elie Aidekon

In joint work with Remco van der Hofstad and Johan van Leeuwaarden, we are interested in asymptotic properties of inhomogeneous random graphs. We currently look at the tail distribution of the re-normalized biggest cluster. He is also interested in various problems of branching random walks on the real line, which are related to the solutions of the F-KPP equation.

### Dimitris Cheliotis

- In a visit to Toronto from December 16 until January 10, I worked on a joint project I have with Balint Virag (Associate Professor at the University of Toronto) that proves a functional law of the iterated logarithm for Sinai's walk and related diffusions. The major part of the work was finished, and in the months since then, I fixed some problems that surfaced after a careful reading. The paper will be submitted after my co-author reads it in its current form, I expect by the end of the year.
- In February and March, I resumed a project I left for one year. It concerns the metastable states for Sinai's walk. I consider the consecutive well depths that give rise to metastable states of increasing stability, and I obtained an explicit description of this process. My next target is to prove a large deviations principle for the number of metastable states visited at a given large time interval. From the first part of the work, I have a candidate rate function, but this proof needs more work. I expect to finish this within the coming academic year.
- I continued working with Frank den Hollander on the pinning problem for directed polymers. The main issue is to study the influence of disorder in the critical phase of a polymer pinned in an interface, and there is a widely known conjecture for it. Last year we were able to cover a large class of polymers where disorder had no influence. Now we extended our results to a more general setting, but there is still work needed to completely solve the problem. This project is my first priority for the following months.

### Sander Dommers

Sander Dommers has, together with Remco van der Hofstad (TU/e and EURANDOM) and Gerard Hooghiemstra (TU Delft), investigated distances in preferential attachment models. They gave bounds on both typical distances in and the diameters of such random graphs. Furthermore, he studied the Ising model on the configuration model together with Cristian Giardinà (TU/e and EURANDOM) and Remco van der Hofstad. They generalized a result of Dembo and Montanari, giving an explicit formula for the thermodynamic limit of the pressure, also when the degree sequence has an infinite variance, but finite mean.

### Robert Fitzner

In the last months we identified the eigensystem of a transition matrix for memory two walk. Moreover we derived an extended version of the lace expansion equation, for the self-avoiding walk and percolation. This results in a matrix-valued lace expansion equation. Right now we evaluate ways to analyze this matrix-valued equation to perform the lace expansion analysis, where we will also need to identify all lace expansion coefficients that we need to compute. In this process we will establish, what the necessary conditions on the lace expansion coefficients are. Then we will derive sharp bounds on the coefficients. Thereby we will first complete the work on the self-avoiding walks to reprove the result that self-avoiding walks display mean-field behavior above dimension 4. Having done this we will try to show that nearest-neighbor percolation above 6 dimensions also displays mean-field behavior.

### Tim Hulshof

We investigate random walks on the incipient infinite cluster for high dimensional percolation models. Specifically our attention is aimed towards gaining a better understanding of the behavior of long-range spread-out percolation models. For instance, several noticeable differences between the volume and effective resistance of long- and finite range percolation clusters become noticeable when random walks on clusters are analyzed in the Euclidean distance metric, as opposed to the graph distance metric.

**Sandra Kliem**

Sandra Kliem has only started working at EURANDOM this October.

She is since then investigating how to combine coalescent behaviour of blocks at same sites with migration on the hierarchical lattice in the spirit of the renormalization program of Dawson and Greven. Furthermore, she kept working on the survival/extinction-behaviour of solutions to the KPP-equation with branching white noise.

**Artem Sapozhnikov**

With Michael Damron (Princeton) and Balint Vagvolgyi (FU-Amsterdam) he was working on problems related to near-critical two-dimensional percolation. In two papers we study so-called invasion percolation on two-dimensional lattices. We obtain a comprehensive description of connectivity structure of the invasion percolation cluster. In particular, we were able to show that the law of the invasion percolation cluster is mutually singular with respect to the law of the incipient infinite cluster. We also made significant progress in understanding the joint law of the so-called ponds of the invasion.

**Lihu Xu**

1. He will mainly concentrate on the project 'renormalization transform' with Frank den Hollander and on the project 'functional inequalities in SPDEs'.

2. He is now very interested in the population dynamics and writing a lecture note on this topic (which is based on the lectures given by Prof. Dawson) for the benefit of him self.

**Workshops and conferences**

In 2009 RSS organized 3 workshops

**Lectures and seminars**

In 2009 RSS organized 12 lectures and seminars (RSS regular and RSS Reading seminars)

**EURANDOM visitors**

In 2009 RSS hosted 9 visitors; altogether for 37 weeks.

## **Statistical Information and Modelling (SIM)**

### **Paulo de Andrade Serra**

Together with Eduard Belitser (UU, EURANDOM) and Harry van Zanten (TUE, EURANDOM), Msc. Paulo Serra has been establishing asymptotical results for an estimator for the period of a non homogeneous Poisson process while studying literature on nonparametric statistics, with focus on Bayesian methodologies, oracles and oracle rates.

### **Shota Gugushvili**

My research interests fall into two broad groups. The first group mainly deals with nonparametric curve estimation problems, in particular deconvolution problems and nonparametric inference for Lévy processes. The second group deals with various approaches to parameter estimation for systems of ordinary differential equations and applications in mathematical biology.

### **Bartek Knapik**

My research is focused mainly on Bayesian statistics, and I study non-regular semiparametric problems. One is of a particular interest - asymptotic behaviour of the marginal posterior for the location parameter for densities with jump.

### **Mikhail Langovoy**

Ongoing research on image analysis, statistical inverse problems, randomized algorithms, stochastic processes, hypothesis testing.

At the moment, the main activity is in application of percolation theory to statistical image analysis. Those results could be extended and applied to statistical analysis of spatio-temporal stochastic models.

### **Workshops and conferences**

In 2009 SIM organized 4 workshops.

### **Lectures and seminars**

In 2009 21 lectures and seminars; all "Informal meetings of Eindhoven Statisticians", co-organized with TU/e-Department of Mathematics and Computer Science.

### **EURANDOM visitors**

In 2009 SIM hosted 2 visitors, altogether 3, 4 weeks.

## **Integrated Batteries (/BAT)**

### **NIMH**

#### **Alexander Ledovskikh**

Together with Dr. D.Danilov and Prof. Dr. P.H.L.Notten, all processes taking place in the NiMH battery have been investigated including main charging-discharging reactions and side overcharging-overdischarging processes. Following our general modelling strategy chemical description of battery processes has been further converted to mathematical equations. Detailed description of the thermodynamic of the MH electrode is given by the Lattice Gas Model (LGM, A. Ledovskikh, D. Danilov, W.J.J. Rey, P.H.L. Notten, Phys. Rev. B, 73 (2006) 014106) which takes into account interactions between absorbed hydrogen atoms and effect of the phase transition taking place during hydrogen storage. Principles of chemical and electrochemical kinetics of the complex hydrogen storage system described in A. Ledovskikh, D. Danilov and P.H.L. Notten, Phys. Rev. B., 76 (2007) 064106; A. Ledovskikh, D. Danilov, P. Vermeulen and P.H.L. Notten, Electrochim. Acta, 55 (2009) 19, were also used in the proposed mathematical description of BMS.

Testing of the new BMS and simulation of the NiMH battery operation using the proposed model will be done during the second phase of the current NEO project (01-12-2009-01-05-2010).

## PUBLICATIONS

### Papers in journals and proceedings per programme

#### Journal articles

Adan, I.J.B.F., Foley, R.D. & McDonald, D.R. (2009). Exact asymptotics for the stationary distribution of a Markov chain: A production model. *Queueing Systems: Theory and Applications*, 62(4), 311-344.

Adan, I.J.B.F., Mandjes, M.R.H., Scheinhardt, W.R.W. & Tzenova, E.I. (2009). On a generic class of two-node queueing systems. *Queueing Systems: Theory and Applications*, 61(1), 37-63.

Adan, I.J.B.F., Economou, A. & Kapodistria, S. (2009). Synchronized reneging in queueing systems with vacations. *Queueing Systems: Theory and Applications*, 62(1), 1-33.

Albrecher, H. & Teugels, J.L. (2009). On excess-of-loss reinsurance. *Theory of Probability and Mathematical Statistics*, 79, 7-22.

Albrecher, H., Borst, S.C., Boxma, O.J. & Resing, J.A.C. (2009). The tax identity in risk theory : A simple proof and an extension. *Insurance: Mathematics and Economics*, 44(2), 304-306.

Andersen, L.N. & Mandjes, M.R.H. (2009). Structural properties of reflected Lévy processes. *Queueing Systems: Theory and Applications*, 63(1-4), 301-322.

Asmussen, S. & Boxma, O.J. (2009). Editorial introduction. *Queueing Systems: Theory and Applications*, 63(1-4), 1-2.

Bar-Lev, S.K., Boxma, O.J., Stadje, W., Duyn Schouten, F.A. van der & Wismeyr, C. (2009). Two-stage queueing network models for quality control and testing. *European Journal of Operational Research*, 198(3), 858-866.

Beekhuizen, P. & Resing, J.A.C. (2009). Performance analysis of small non-uniform packet switches. *Performance Evaluation*, 66(11), 640-659.

Bekker, R. & Mandjes, M.R.H. (2009). A fluid model for a relay node in an ad hoc network: the case of heavy-tailed input. *Mathematical Methods of Operations Research*, 70(2), 357-384.

Boon, M.A.A. & Adan, I.J.B.F. (2009). Mixed gated/exhaustive service in a polling model with priorities. *Queueing Systems: Theory and Applications*, 63(1-4), 383-399.

Bordenave, C., Foss, S.G. & Shneer, V. (2009). A random multiple access protocol with spatial interactions. *Journal of Applied Probability*, 46(3), 844-865.

Boxma, O.J. & Perry, D. (2009). On the cycle maximum of mountains, dams and queues. *Communications in Statistics. Part A, Theory and Methods*, 38(16-17), 2706-2720.

Boxma, O.J., Bruin, J. & Fralix, B.H. (2009). Sojourn times in polling systems with various service disciplines. *Performance Evaluation*, 66(11), 621-639.

Boxma, O.J., Perry, D., Stadje, W. & Zacks, S. (2009). The M/G/1 queue with quasi-restricted accessibility. *Stochastic Models*, 25(1), 151-196.

Caravenna, F. & Pétrelis, N.R. (2009). A polymer in a multi-interface medium. *The Annals of Applied Probability*, 19(5), 1803-1839

Contucci, P., Giardinà, C. & Giberti, C. (2009). Interaction-flip identities in spin glasses. *Journal of Statistical Physics*, 135(5-6), 1181-1203.

Contucci, P., Giardinà, C., Giberti, C., Parisi, G. & Vernia, C. (2009). Structure of correlations in three dimensional spin glasses. *Physical Review Letters*, 103(1), 017201-1/4.

Danilov, D. & Notten, P.H.L. (2009). Li-ion electrolyte modeling: The impact of adding supportive salts.



*Journal of Power Sources*, 189(1), 303-308.

Debicki, K.G., Es-Saghouani, A. & Mandjes, M.R.H. (2009). Transient characteristics of Gaussian queues. *Queueing Systems: Theory and Applications*, 62(4), 383-409.

Es-Saghouani, A. & Mandjes, M.R.H. (2009). On the dependence structure of Gaussian queues. *Stochastic Models*, 25(2), 221-247.

Es-Saghouani, A. & Mandjes, M.R.H. (2009). Transient analysis of Markov-fluid-driven queues. *TOP*, to appear.

Fralix, B.H. & Adan, I.J.B.F. (2009). An infinite-server queue influenced by a semi-Markovian environment. *Queueing Systems: Theory and Applications*, 61(1), 65-84.

Gärtner, J., Hollander, W.Th.F. den & Maillard, G. (2009). Intermittency on catalysts: three-dimensional simple symmetric exclusion. *Electronic Journal of Probability*, 14, 2091-2129.

Gaudillière, A., Hollander, W.Th.F. den, Nardi, F.R., Olivieri, E. & Scoppola, E. (2009). Ideal gas approximation for a two-dimensional rarefied gas under Kawasaki dynamics. *Stochastic Processes and their Applications*, 119(3), 737-774.

Göbel, J., Krzesinski, A. & Mandjes, M.R.H. (2009). Incentive-based control of ad hoc networks: A performance study. *Computer Networks*, 53(4), 2427-2443.

Gonchigdanzan, K. & Kosinski, K.M. (2009). On the functional limits for partial sums under stable law. *Statistics & Probability Letters*, 79(17), 1818-1822.

Gugushvili, S. (2009). Nonparametric estimation of the characteristic triplet of a discretely observed Lévy process. *Journal of Nonparametric Statistics*, 21(3), 321-343.

Hauser, R. & Müller, T. (2009). Conditioning of random conic systems under a general family of input distributions. *Foundations of Computational Mathematics*, 9(3), 335-358.

Heydenreich, M.O., Hofstad, R.W. van der & Radulov, G.I. (2009). Functionals of Brownian bridges arising in the current mismatch in D/A converters. *Probability in the Engineering and Informational Sciences*, 23(1), 149-172.

Hofstad, R.W. van der, Kager, W. & Müller, T. (2009). A local limit theorem for the critical random graph. *Electronic Communications in Probability*, 14, 122-131.

Hollander, W.Th.F. den & Pétrélis, N.R. (2009). A mathematical model for a copolymer in an emulsion. *Journal of Mathematical Chemistry*, 1-12.

Hollander, W.Th.F. den & Pétrélis, N.R. (2009). On the localized phase of a copolymer in an emulsion: subcritical percolation regime. *Journal of Statistical Physics*, 134(2), 209-241.

Hollander, W.Th.F. den & Pétrélis, N.R. (2009). On the localized phase of a copolymer in an emulsion: supercritical percolation regime. *Communications in Mathematical Physics*, 285(3), 825-871.

Janssen, A.J.E.M. & Leeuwaarden, J.S.H. van (2009). Equidistant sampling for the maximum of a Brownian motion with drift on a finite horizon. *Electronic Communications in Probability*, 14, 143-150.

Jönsson, H. & Schoutens, W. (2009). Pricing constant maturity credit default swaps. *The Journal of Credit Risk*, 5(1), 1-21.

Kopzon, A., Nazarathy, Y. & Weiss, G. (2009). A push-pull network with infinite supply of work. *Queueing Systems: Theory and Applications*, 62(1-2), 75-111.

Kosinski, K.M. (2009). On the functional limits for sums of a function of partial sums. *Statistics & Probability Letters*, 79(13), 1522-1527.

Ledovskikh, A., Danilov, D., Vermeulen, P. & Notten, P.H.L. (2009). Electrochemical modeling of hydrogen storage in hydride-forming electrodes. *Electrochimica Acta*, 55(1), 19-30.

Leeuwaarden, J.S.H. van & Temme, N.M. (2009). Asymptotic inversion of the Erlang B formula. *SIAM Journal on Applied Mathematics*, 70(1), 1-23.

Leeuwaarden, J.S.H. van, Squillante, M.S. & Winands, E.M.M. (2009). Quasi-birth-and-death processes, lattice path counting, and hypergeometric functions. *Journal of Applied Probability*, 46(2), 507-520.

Leeuwaarden, J.S.H. van, Löpker, A.H. & Ott, T.J. (2009). TCP and iso-stationary transformations. *Queueing Systems: Theory and Applications*, 63(1-4), 459-475.

Malhotra, R., Mandjes, M.R.H., Scheinhardt, W.R.W. & Berg, J.L. van den (2009). A feedback fluid queue with two congestion control thresholds. *Mathematical Methods of Operations Research*, 70(1), 149-169.

Malhotra, R., Mandjes, M.R.H., Scheinhardt, W.R.W. & Berg, J.L. van den (2009). Design issues of a back-pressure-based congestion control mechanism. *AEÜ - International Journal of Electronics and Communications*, to appear.

Mandjes, M.R.H. & Roijers, F. (2009). M/M/ $\infty$  transience: tail asymptotics of congestion periods. *Stochastic Models*, 25(4), 614-647.

Silvestrov, D.S., Jönsson, H. & Stenberg, F. (2009). Convergence of option rewards for Markov type price processes modulated by stochastic indices. I. *Theory of Probability and Mathematical Statistics*, 79, 153-170.

Tan, H.P., Núñez Queija, R., Gabor, A.F. & Boxma, O.J. (2009). Admission control for differentiated services in future generation CDMA networks. *Performance Evaluation*, 66(9-10), 488-504.

Ven, P.M. van de & Di Bucchianico, A. (2009). On the equivalence of definitions for regular fractions of mixed-level factorial designs. *Journal of Statistical Planning and Inference*, 139(7), 2351-2361.

Vermeulen, P., Ledovskikh, A., Danilov, D. & Notten, P.H.L. (2009). Thermodynamics and kinetics of the thin film magnesium-hydrogen system. *Acta Materialia*, 57(17), 4967-4973.

Vlasiou, M., Adan, I.J.B.F. & Boxma, O.J. (2009). A two-station queue with dependent preparation and service times. *European Journal of Operational Research*, 195(1), 104-116.

Xu, L. & Zegarlinski, B. (2009). Ergodicity of the finite and infinite dimensional  $\alpha$ -stable systems. *Stochastic Analysis and Applications*, 27(4), 797-824.

### Book chapter

Hollander, W.Th.F. den (2009). Three lectures on metastability under stochastic dynamics. In R. Kotheck (Ed.), *Methods of Contemporary Mathematical Statistical Physics* (Lecture Notes in Mathematics, 1970) (pp. 223-246). Berlin: Springer.

Jönsson, H., Schoutens, W. & Damme, G. van (2009). Modeling default and prepayment using Lévy processes: An application to asset backed securities. In H. Albrecher, W.J. Runggaldier & W. Schachermayer (Eds.), *Advanced Financial Modelling* (Radon Series on Computational and Applied Mathematics, 8) (pp. 183-204). Berlin: De Gruyter.

### Conference proceeding

Beekhuizen, P. & Resing, J.A.C. (2009). Approximation of discrete-time polling systems via structured Markov chains. In *Proceedings 4th International Workshop on Tools for Solving Structured Markov Chains (SMCTools 2009, Pisa, Italy, October 19, 2009; co-located with ValueTools 2009)* to appear.

Cirillo, E.N.M., Nardi, F.R. & Spitoni, C. (2009). Competitive nucleation in metastable spin system. In - *Vol. 3. Communications to SIMAI Congress*.

Guillaume, F.M.Y. & Schoutens, W. (2009). The standard VG volatility space model: delta-hedging performance. In *Colloquium Simulation in Industry and Services (SIS 2009, Brussels, Belgium, December 4, 2009)* to appear.

Hoekstra, G., Mei, R.D. van der, Nazarathy, J. & Zwart, A.P. (2009). Optimal file splitting for wireless networks with concurrent access. In R. Núñez Queija & J.A.C. Resing (Eds.), *Network Control and Optimization (Third Euro-NF Conference, NET-COOP 2009, Eindhoven, The Netherlands, November 23-25, 2009. Proceedings) Vol. 5894. Lecture Notes in Computer Science* (pp. 189-203). Berlin: Springer.

Ven, P.M. van de, Borst, S.C. & Shneer, V. (2009). Instability of MaxWeight scheduling algorithms. In *Proceedings 28th IEEE International Conference on Computer Communications (INFOCOM 2009, Rio de Janeiro, Brazil, April 19-25, 2009)* (pp. 1701-1709). IEEE.

## External report (other than EURANDOM reports)

Contucci, P., Giardinà, C., Giberti, C., Parisi, G. & Vernia, C. *On the structure of correlations in the three dimensional spin glasses*. arXiv.org [cond-mat.dis-nn] (Ext. rep. 0902.0594).

Damron, M. & Sapozhnikov, A. *Outlets of 2D invasion percolation and multiple-armed incipient infinite clusters*. arXiv.org [math.PR] (Ext. rep. 0903.4496).

Ivanovs, J. & Mandjes, M.R.H. *On the record process of time-reversible spectrally-negative Markov additive processes*. CWI Report (Ext. rep. PNA-E0903). Amsterdam: CWI.

Lieshout, M.N.M. van *Moment analysis of the Delaunay tessellation field estimator*. CWI Report (Ext. rep. PNA-E0914). Amsterdam: CWI.

Nazarathy, Y. & Weiss, G. *A fluid approach to job shop scheduling: theory, software and experimentation*. SE Report (Ext. rep. 2009-07). Eindhoven: Technische Universiteit Eindhoven.

Romito, M. & Xu, L. *Ergodicity of the 3D stochastic Navier-Stokes equations driven by mildly degenerate noise*. arXiv.org [math.PR] (Ext. rep. 0906.4281).

Vlasiou, M. & Palmowski, Z.B. *Large deviations for a random sign Lindley recursion*. Eurandom Report (Ext. rep. 2009-003). Eindhoven: Technische Universiteit Eindhoven.

Xu, L. *Ergodicity of infinite white  $\alpha$ -stable systems with linear and bounded interactions*. arXiv.org [math.PR] (Ext. rep. 0911.2868).

Xu, L. & Zegarlinski, B. *Existence and exponential mixing of infinite white  $\alpha$ -stable systems with unbounded interactions*. arXiv.org [math.PR] (Ext. rep. 0911.2866).

Xu, L., Alberverio, S. & Debussche, A. *Exponential mixing of the 3D stochastic Navier-Stokes equations driven by mildly degenerate noises*. arXiv.org [math.PR] (Ext. rep. 0910.0614).

## EURANDOM Reports

Report No.	Title	Author(s)	Group
2009-065	<a href="#">Critical behavior in inhomogeneous random graphs</a>	R. v.d. Hofstad	RSS
2009-064	<a href="#">Random graph asymptotics on high-dimensional tori II. Volume, diameter and mixing time</a>	M. Heydenreich R. v.d. Hofstad	RSS
2009-063	<a href="#">First passage percolation on random graphs with finite mean degrees</a>	S. Bhamidi R. v.d. Hofstad	RSS

		G. Hooghiemstra	
2009-062	<a href="#">Extreme value theory, Poisson-Dirichlet distributions and FPP on random networks</a>	S. Bhamidi R. v.d. Hofstad	RSS
2009-061	<a href="#">Refined square-root staffing for call centers with impatient customers</a>	B. Zhang J. v. Leeuwen B. Zwart	QPA
2009-060	<a href="#">Triangular M/G/1-type and tree-like QBD Markov chains</a>	B. van Houdt J. van Leeuwen	QPA
2009-059	<a href="#">Rare events asymptotics for a random walk in the quarter plane</a>	F. Guillemin J. van Leeuwen	QPA
2009-058	<a href="#">TCP and ISO-stationary transformations</a>	J. van Leeuwen A. Löpker T. Ott	QPA
2009-057	<a href="#">Sojourn time tails in the single server queue with heavy-tailed service times</a>	O. Boxma D. Denisov	QPA
2009-056	<a href="#">Improving the Delta-hedging risk-adjusted performance: the standard VG volatility space model</a>	F. Guillaume W. Schoutens	MRM
2009-055	<a href="#">A saturated tree network of polling stations with flow control</a>	P. Beekhuizen J. Resing	QPA
2009-054	<a href="#">Workload-dependent capacity in production-to-order systems</a>	N. Dellaert G. Mincovics	QPA
2009-053	<a href="#">Hospital admission planning to optimize major resources utilization under uncertainty</a>	N. Dellaert J. Jeunet	QPA
2009-052	<a href="#">Improving operational effectiveness of tactical master plans for emergency and elective patients under stochastic demand and capacitated resources</a>	I. Adan J. Bekkers N. Dellaert J. Jeunet J. Vissers	QPA
2009-051	<a href="#">Budget Allocation for Permanent and Contingent Capacity under Stochastic Demand</a>	N. Dellaert J. Jeunet G. Mincovics	QPA
2009-050	<a href="#">Asset backed securities: Risks, Ratings and Quantitative Modelling</a>	H. Jönsson W. Schoutens	MRM
2009-049	<a href="#">First passage process of a Markov additive process, with applications to reflection problems</a>	B. D'Auria J. Ivanovs O. Kella M. Mandjes	QPA
2009-048	<a href="#">First passage of time-reversible spectrally-negative Markov additive processes</a>	J. Ivanovs M. Mandjes	QPA
2009-047	<a href="#">Novel scaling limits for critical inhomogeneous random graphs</a>	S. Bhamidi R. van der Hofstad J. van Leeuwen	RSS
2009-046	<a href="#">On a processor sharing queue that models balking</a>	Q. Zhen J. van Leeuwen Ch. Knessl	RSS
2009-045	<a href="#">The Variance of Departure Processes: Puzzling Behavior and Open Problems</a>	Y. Nazarathy	QPA
2009-044	<a href="#">Scaling limits for critical inhomogeneous random graphs</a>	S. Bhamidi	QPA

	<a href="#">with finite third moments</a>	R. van der Hofstad J. van Leeuwen	
2009-043	<a href="#">End-to-end delays in polling tree networks</a>	P. Beekhuizen T. Denteneer J. Resing	QPA
2009-042	<a href="#">Approximation of discrete-time polling systems via structured Markov chains</a>	P. Beekhuizen J. Resing	QPA
2009-040	<a href="#">A Survey on Performance Analysis of Warehouse Carousel Systems</a>	N. Litvak M. Vlasiov	QPA
2009-039	<a href="#">A Polling Model with Reneging at Polling Instants</a>	M. Boon	QPA
2009-038	<a href="#">A Polling Model with Smart Customers</a>	M. Boon A. van Wijk I. Adan	QPA
2009-037	<a href="#">Tandem queues with impatient customers for blood screening procedures</a>	S.K. Bar-Lev H. Blanc O. Boxma D. Perry	QPA
2009-036	<a href="#">Busy period analysis of the level dependent PH/PH/1/K Queue</a>	A. Al Hanbali	QPA
2009-035	<a href="#">Detection of objects in noisy images and site percolation on square lattices</a>	M. Langovoy O. Wittich	SIM
2009-034	<a href="#">Predicting cycle time distributions for integrated processing workstations: an aggregate modeling approach</a>	C. Veeger L. Etman E. Lefeber I. Adan J. van Herk	QPA
2009-033	<a href="#">Large deviation principle for one-dimensional random walk in dynamic random environment: attractive spin-flips and simple symmetric exclusion</a>	L. Avena F. den Hollander F. Redig	RSS
2009-032	<a href="#">Law of large numbers for a class of random walks in dynamic random environments</a>	L. Avena F. den Hollander F. Redig	RSS
2009-031	<a href="#">Algebraic polynomials and moments of stochastic integrals</a>	M. Langovoy	SIM
2009-030	<a href="#">Closed-Form Waiting Time Approximations for Polling Systems</a>	M. Boon E. Winands I. Adan S. van Wijk	QPA
2009-029	<a href="#">Stability of multi-dimensional birth-and-death process with state-dependent 0-homogeneous jumps</a>	M. Jonckheere S. Shneer	QPA
2009-028	<a href="#">Analysis of an M/G/1 queue with customer impatience and an adaptive arrival process</a>	O. Boxma B. Prabhu	QPA
2009-027	<a href="#">Optimal lateral transshipment policy for a two location inventory problem</a>	S. van Wijk I. Adan G.J. van Houtum	QPA
2009-026	<a href="#">Lévy-driven polling systems and continuous-state branching processes</a>	O. Boxma J. Ivanovs K. Kosinski M. Mandjes	QPA
2009-025	<a href="#">A Characterization Related to the Equilibrium Distribution Associated with a Polynomial Structure</a>	S.K. Bar-Lev O. Boxma G. Letac	QPA

2009-024	<a href="#">On the Cycle Maximum of Mountains, Dams and Queues</a>	O. Boxma D. Perry	QPA
2009-023	<a href="#">Delay in a Tandem Queueing Model with Mobile Queues: An Analytical Approximation</a>	A. Al Hanbali	QPA
2009-022	<a href="#">Time-limited polling systems with batch arrivals and phase-type service times</a>	A. Al Hanbali	QPA
2009-021	<a href="#">Intermittency on catalysts: voter model</a>	J. Gärtner F. den Hollander G. Maillard	RSS
2009-020	<a href="#">Equilibrium joining probabilities for an M/G/1 queue</a>	Y. Kerner	QPA
2009-019	<a href="#">Transient Analysis of the State Dependent M/M/1/K Queue</a>	A. Al Hanbali O. Boxma	QPA
2009-018	<a href="#">Some invariance properties of monotone failure rate in the M/G/1 queue</a>	Y. Kerner	QPA
2009-017	<a href="#">Another look at the transient behavior of the M/G/1 workload process</a>	B. Fralix	QPA
2009-016	<a href="#">Optimal File Splitting for Wireless Networks With Concurrent Access</a>	G. Hoekstra R. v.d. Mei Y. Nazarathy B. Zwart	QPA
2009-015	<a href="#">Asymptotic normality of the deconvolution kernel density estimator under the vanishing error variance</a>	B. van Es S. Gugushvili	SIM
2009-014	<a href="#">Nonparametric estimation of the characteristic triplet of a discretely observed Lévy process</a>	S. Gugushvili	SIM
2009-013	<a href="#">Comparing Markov chains: Combining aggregation and precedence relations applied to sets of states</a>	A. Busic I. Vliegen A. Scheller-Wolf	QPA
2009-012	<a href="#">The Busy Period of an M/G/1 Queue with Customer Impatience</a>	O. Boxma D. Danilov D. Perry W. Stadjé S. Zacks	QPA
2009-011	<a href="#">Hitting Times and the Running Maximum of Markovian Growth Collapse Processes</a>	A. Löpker W. Stadjé	QPA
2009-010	<a href="#">An alternating risk reserve process - Part II</a>	O. Boxma H. Jönsson J. Resing S. Shneer	QPA
2009-009	<a href="#">An alternating risk reserve process - Part I</a>	O. Boxma H. Jönsson J. Resing S. Shneer	QPA

2009-008	<a href="#">New hydride-forming materials: challenges towards a new generation of high energy density Nickel-Metal-Hybride batteries</a>	<a href="#">Abstract 2009-008</a>	A. Ledovskikh D. Danilov A. Ayeb P. Notten	SIM
2009-007	<a href="#">Model selection, large deviations and consistency of data-driven tests</a>	<a href="#">Abstract 2009-007</a>	M. Langovoy	SIM
2009-006	<a href="#">Fast Valuation and Calibration of Credit Default Swaps Under Lévy Dynamics</a>	<a href="#">Abstract 2009-006</a>	F. Fang H. Jönsson C. Oosterlee W. Schoutens	MRM
2009-005	<a href="#">Heavy-traffic analysis of the maximum of an asymptotically stable random walk</a>	<a href="#">Abstract 2009-005</a>	S. Shneer V. Wachtel	QPA
2009-004	<a href="#">New Models for Rating Asset Backed Securities</a>	<a href="#">Abstract 2009-004</a>	H. Jönsson W. Schoutens G. v. Damme	MRM
2009-003	<a href="#">Large deviations for a random sign Lindley recursion</a>	<a href="#">Abstract 2009-003</a>	M. Vlasiou Z. Palmowski	QPA
2009-002	<a href="#">A Lévy input model with additional state-dependent services</a>	<a href="#">Abstract 2009-002</a>	Z. Palmowski M. Vlasiou	QPA
2009-001	<a href="#">An upper bound for front propagation velocities inside moving populations</a>	<a href="#">Abstract 2009-001</a>	A. Gaudillière F. Nardi	RSS

In 2009 65 **EURANDOM reports** were written, while the website of the department of Mathematics and Computer Sciences mentions 67 **external publications**.

[http://oametuep.uci.ru.nl/metue/pk\\_apa\\_n.onderzoek?p\\_url\\_id=5205](http://oametuep.uci.ru.nl/metue/pk_apa_n.onderzoek?p_url_id=5205)

#### Distribution per programme:

	EURANDOM Reports	Journals	external reports	conference proceedings	book chapter
QPA	44	31	1	3	--
RSS	10	12	6	1	1
SIM	7	2	1	-	--
MRM	4	4	--	1	1
Bat/NiMH	---	3	--	--	--
	<u>65</u>	<u>52</u>	<u>8</u>	<u>5</u>	<u>2</u>

## ACTIVITIES

### Workshops and Conferences in 2009

December 14-18, 2009 (RSS)  
Dynamic Random Environments

November 23-25, 2009 (QPA)  
NET-COOP

November 19-21, 2009 (QPA)  
YEQT-III Scheduling and Resource Sharing in Queueing Networks

October 29-30, 2009 (QPA)  
Stochastic models for warehousing systems

October 29-30, 2009 (MRM)  
Asset Backed Securities

October 5-7, 2009 (SIM)  
YES-III Paradigms of Model Choice

August 24-28, 2009 (RSS)  
Order, disorder and double disorder

July 15-17, 2009 (SIM)  
Statistical inference for Lévy Processes with Applications to Finance

June 25 & 26, 2009 (QPA)  
SPOTNET meeting

June 8-10, 2009 (SIM)  
Parameter Estimation for Dynamical Systems

May 11-13, 2009 (SIM)  
Climate change and extreme value theory

March 23-27, 2009 (RSS)  
YEP-VI Fragmentation, coalescence and probabilistic genetics

January 5-7, 2009 (QPA)  
Quantitative Models for Production and Communication Networks

Furthermore, on December 14, we celebrated the 100<sup>th</sup> workshop at EURANDOM. See for a complete list: [http://www.eurandom.tue.nl/events/100/all\\_workshops.htm](http://www.eurandom.tue.nl/events/100/all_workshops.htm)

EURANDOM sponsored the Nederlands Mathematisch Congres 2009, which took place on April 14 and 15, 2009 in Groningen.

### Details on the workshops

January 5-7, 2009 (QPA)  
Quantitative Models for Production and Communication Networks

#### Organizers:

Ivo Adan, Eindhoven University of Technology  
Geert-Jan van Houtum, Eindhoven University of Technology  
Alan Scheller-Wolf, Carnegie Mellon University

**Participants:** 30



The workshop topic: Both Carnegie Mellon University (CMU) and Eindhoven University of Technology (TU/e), conduct research in the area of quantitative models for production/inventory and communication systems. There is significant overlap in the type of the problems that are studied, as well as in the style of the research performed. The objective of this workshop was to discuss future research directions and to investigate the possibilities for joint research projects and exchange of PhD students. The workshop consisted of many presentations of participants from CMU and TU/e. The CMU speakers were: Willem-Jan van Hoeve, Bahar Biller, Mustafa Akan, Nicola Secomandi, Robert Hampshire, Gabriella Muratore, Erkut Sonmez, Ana Busic, Marha Shunko, Anshul Gandhi and Paul Enders. The speakers from TU/e were: Jacques Resing, Marco Slikker, Ton de Kok, Gerhard Woeginger, Jan van der Wal, Maria Vlasίου, Sandra van Wijk, Matthias Mnich, Josine Bruin and Kurtulus Öner. Apart from talks, there was also a company visit to ASML, including a factory tour and presentations of new challenges at ASML with respect to the supply chain for new machines. During the 3-day workshop these ASML real-life problems were discussed in groups, the outcomes of which were presented in a feedback session to ASML. In addition, there was also plenty of time for group discussions on possible joint research projects. The meeting was very successful, especially the involvement of ASML and the group discussions on possible joint research projects. It has led to a further strengthening of the ties between CMU and TU/e, and initiated new collaborations and exchanges.

#### **Sponsors:**

TU/e research cluster Logistics, Operations, and their Information Systems (LOIS)

**March 23-27, 2009 (RSS)**

**YEP VI (Young European Probabilists) - Fragmentation, coalescence and probabilistic genetics**

#### **Organizers:**

Peter Moerters, University of Bath

Julien Berestycki, Université Pierre et Marie Curie

#### **Participants: 45**

This workshop was the sixth in a successful series of YEP meetings at EURANDOM in the years 2004-2009. This year, the main focus of the workshop was on "Fragmentation, coalescence and probabilistic genetics". Fragmentation processes model situations in which an object falls apart with time (e.g. through splitting, erosion or break-ups) while coalescence processes describe systems where clusters aggregate to form larger structures (e.g. through coagulation, gelation or aggregation). These processes have been the focus of a lot of attention in recent years, partly because of the wide variety of contexts in which they appear (for example in population genetics and evolutionary biology, physical chemistry or astrophysics) and partly because of the rich relations to other important areas of probability research, such as branching processes, random trees or random self-similar structures. The main focus of the workshop was on new mathematical developments and applications to populations genetics.

The workshop was organized around two mini-courses. Nathanaël Berestycki (University of Cambridge) gave a course about *coalescent processes and population genetics* while Bénédicte Haas (Université Paris Dauphine) focused on *Self-similar fragmentations and random real trees*. The speakers, which are top experts in their fields, were very mindful of their audience and managed to present some of the most advanced and recent developments in this field with exceptional clarity and interest. Both mini-courses were of exceptional quality and interest.

Matthias Birkner and Alexander Gnedin contributed to the success of this edition of YEP by giving two excellent lectures: Matthias Birkner's topic was *Lambda coalescents and population genetic inference* while Alexander Gnedin had a two-parts programme *Regenerative partitions* and *A coupling method for exchangeable coalescents*.

This workshop gathered 45 registered participants, most of them at an early stage of their career, typically in the final phase of their PhD or PD, coming from several European countries. The two-fold goal of YEP - exposing young researchers to new and exciting directions in Probability on the one hand and fostering interactions and collaborations between them - was successfully achieved. Sixteen participants were asked to give a talk, and the quality and variety of their presentations contributed greatly to the success of this workshop. Finally the friendly and informal atmosphere in which the week was spent encouraged the intense scientific curiosity of the participants, encouraged exchanges and scientific bonds and made this event a very enjoyable experience.

The titles, abstracts, slides and lecture notes of these talks and lectures can be found at [http://www.eurandom.tue.nl/workshops/2009/YEPVI/YEpVI\\_abstracts.htm](http://www.eurandom.tue.nl/workshops/2009/YEPVI/YEpVI_abstracts.htm).

**Sponsors:** Eindhoven University of Technology, Thomas Stieltjes Institute for Mathematics, Netherlands Organization for Scientific Research (NWO)

**May 11-13, 2009 (SIM)**  
**Climate Change and Extreme Value Theory**

**Organizers:**

Wilco Hazeleger, KNMI  
Geurt Jongbloed, TU Delft & EURANDOM  
Jef Teugels, KU Leuven & EURANDOM  
Arnoldo Frigessi, University of Oslo

**Participants:** 55

The earth's climate can be characterized by a number of parameters. E.g. annual regional averages of temperature and rainfall, distribution of rainfall over a year and average wind intensity and direction. These parameters clearly show variability, depending on the location and time.

It is very important to study the variation in these climate parameters over a longer period of time, especially trends that indicate non-stationarity of their behaviour are of interest in order to attribute them to natural or anthropogenic causes. Studying possible causes for these trends, quantitative aspects of these trends and consequences for human, animal and plant life of these trends is important for reasons of safety, economy and quality of life for future generations.

Many researchers around the world work on aspects of climate change, e.g. people in climate studies, oceanography, mathematics, physics, economics etc. The stochastic methods used come from a broad range of subfields of stochastics, e.g. stochastic modelling, stochastic simulation, inverse problems, stochastic processes, extreme value statistics, curve estimation, time series analysis etc.

This workshop focuses on extreme value statistics in the context of climate change. The aim is cross fertilization, communication and interaction between people that work on extreme value statistics and climate studies.

The first and last day of the workshop were held at EURANDOM in Eindhoven, the second day at KNMI in De Bilt. On Monday there were four invited talks, on Tuesday three and on Wednesday two. On Tuesday, the group was divided in four subgroups. These groups were given one of two problems (one proposed by Wilco Hazeleger, KNMI, and one by Richard Smith, UNC) and asked to provide a solution direction. The groups were constructed in such a way that each group had senior and junior members as well as members from the field of climate research and statistics. On Wednesday, the groups were asked to present their results plenary.

The invited speakers were:

Anthony C. Davison, Institute of Mathematics, Ecole Polytechnique Federale de Lausanne, Switzerland  
Gabriele C. Hegerl, School of Geosciences, University of Edinburgh, UK  
Albert Klein Tank, Climate Research and Seismology, KNMI, The Netherlands  
Douglas W. Nychka, National Center for Atmospheric Research Boulder, USA  
Rolf-Dieter Reiss, Department of Mathematics, Universität Siegen, Germany  
Holger Rootzén, Department of Statistics, Chalmers University of Technology, Gothenburg, Sweden  
Richard L. Smith, Department of Statistics and Operations Research University of North Carolina, USA  
David B. Stephenson, Department of Mathematics, Exeter Climate Studies, University of Exeter and Hadley Centre, UK  
Andreas Sterl, Climate Research and Seismology, KNMI, The Netherlands

Speakers that unfortunately had to cancel, were

David Battisti, Department of Atmospheric Sciences, University of Washington, Seattle, USA  
Arnoldo Frigessi, Department of Biostatistics, University of Oslo, Norway  
Sidney Resnick, School of Operations Research and Information Engineering, Cornell University, USA  
Hans von Storch, Meteorological Institute, University of Hamburg, Germany

Excluding the speakers and two organizers, the participants were from The Netherlands (22), UK (8), Sweden (2), Norway (1), Estonia (1), Poland (2), Bulgaria (1), Canada (1), Germany (2), Argentina (1),

Spain (3) and Austria (1). There was also a good mix in seniority and background (climate studies, statistics).

During this workshop, the presentations lead to fruitful discussions and interaction. People from climate studies have learned about recent developments in the field of extreme value theory that are highly relevant for them. People from statistics have learned about the statistical problems people in climate research are confronted with. EURANDOM and KNMI see possibilities in starting joint projects on statistical approaches to problems in climate studies.

**Sponsors:**

Royal Netherlands Meteorological Institute (KNMI), Mathematical Research Institute (MRI), Netherlands Organization for Scientific Research (NWO), Thomas Stieltjes Institute for Mathematics, NWO Earth and Life Sciences (ALW).

**June 8-10, 2010 (SIM)**

**Parameter Estimation for Dynamical Systems**

**Organizers:**

Chris Klaassen, Universiteit van Amsterdam & EURANDOM  
Shota Gugushvili, EURANDOM  
Bart Bakker, Philips Research

**Participants: 50**

There were eight presentations by invited speakers, seven contributed talks, a poster session with eight posters, and a panel discussion on present state and future of the field.

Systems of ordinary differential equations (ODEs) play an important role in modelling various phenomena that arise in fields as diverse as biology, engineering, chemistry, meteorology, and many others. Typically, these systems are nonlinear and depend on parameters. For instance, in biomolecular applications these parameters describe interaction rates and initial concentrations of various molecules relevant to a given biomolecular process. In order to obtain a model useful in practice, it is critical to know these parameters. They have to be inferred from data related to the process at hand. Typically, the dimensions of both the ODE system as well as the parameter space are high, while data are relatively scarce. Hence estimation of parameters of ODE systems is a challenging problem that lies at an intersection of several theoretical and applied fields. The workshop has been very successful in providing a meeting place for researchers in the area, who reviewed different methods used to tackle the problem, assessed the achieved progress, and identified future research directions.

Classical Least Squares Estimation was discussed by Piet Hemker, the Bayesian approach by Dave Lunn and Dave Campbell, smoothing techniques by Jim Ramsay and former EURANDOM-postdoc Nicolas Brunel, a nonlinear programming approach by Victor Zavala, and applications by Kim McAuley. A general overview was given by Eberhard Voit. The contributed papers and posters also touched on several of these topics. It was a good mixture of the theoretical and more applied contributions for an audience and by speakers with diverse backgrounds.

The workshop has drawn attention to this new field, has been very informative for the participants, and has fostered collaboration by its pleasant and inspiring atmosphere.

Publication of proceedings in a journal is under discussion. A follow-up workshop might be planned in two years.

**Sponsors:**

Royal Netherlands Academy of Arts and Sciences (KNAW), Netherlands Bioinformatics Centre (NBIC), Netherlands Organization for Scientific Research (NWO), Philips.

**June 25 & 26, 2009 (QPA)**

**SPOTNET meeting**

**Organizers:**

Seva Shneer, EURANDOM

**Participants: 8**

This third meeting of the participants of a special joint EURO-NF project entitled "Spatial Stochastic Networks for the Future Internet" (SPOTNET) was held on June 25 and 26 at EURANDOM. The first meeting was held in Helsinki (hosted by Helsinki University of Technology) and the second - in Edinburgh (hosted by Heriot-Watt University). The goal of the meetings is to bring together researchers participating in the project, to give them an opportunity to share their latest results and to discuss plans for future research activities and collaborative efforts. The meeting was attended by Jarno Nousiainen and Jorma Virtamo (TKK Helsinki), Denis Denisov and Stan Zachary (Heriot-Watt University, Edinburgh) and several people from EURANDOM and TU/e. Talks were given by Johan van Leeuwen (EURANDOM and TU/e), Jarno Nousiainen (TKK Helsinki), Peter van de Ven (EURANDOM and TU/e) and Stan Zachary (Heriot-Watt University Edinburgh). There was some free time between and after the talks which facilitated a lot of interesting and fruitful discussions.

**Sponsors:**

Network of Excellence – Euro-NF

**July 15 - 17, 2009 (SIM)****Statistical Inference for Lévy Processes with Applications to Finance****Organizers:**

Chris Klaassen, Universiteit van Amsterdam & EURANDOM

Shota Gugushvili, EURANDOM

Peter Spreij, Universiteit van Amsterdam

**Participants: 58**

Recent years have witnessed great interest in financial models based on Lévy processes as possible alternatives to the traditional Black-Scholes model of financial markets. An appealing feature of models based on Lévy processes is their ability to reproduce important stylized features of financial time series. Moreover, there exists a well-developed mathematical (probabilistic) theory for Lévy processes. As any stochastic model, a financial model based on a Lévy process depends on various parameters (finite, or possibly infinite-dimensional). Estimation of these parameters, or, in financial terminology, calibration of the model to the available data, is of critical importance to successful applications of these models in practice. This is a new and challenging area of statistical research.

The workshop has drawn attention to this new field, has been very informative for the participants, and has fostered collaboration by its pleasant and inspiring atmosphere. It provided an excellent meeting place for researchers in the area, who reviewed different methods used to tackle estimation problems for Lévy processes, assessed the achieved progress, and identified future research directions. The workshop featured a good mixture of theoretical and more applied contributions by speakers with diverse backgrounds. Parametric, nonparametric, and semi parametric approaches to inference problems for Lévy processes all received due attention. There were 11 presentations by invited speakers and 12 contributed talks.

An agreement has been reached with Statistica Neerlandica to publish the proceedings of the workshop as a special issue. A follow-up workshop might be planned in the future.

**Sponsors:**

Mathematical Research Institute (MRI), Netherlands Organization for Scientific Research (NWO), Thomas Stieltjes Institute for Mathematics, ESF-Advanced Mathematical Methods for Finance (AMAMEF).

**August 24-28, 2009 (RSS)****Order, disorder, and double disorder****Organizers:**

Aernout van Enter, University of Groningen

Roberto Fernández, Université de Rouen

Christof Kuelske, University of Groningen

**Participants: 35**

This workshop was held on the topic of models, especially models having their origin in statistical mechanics, in which two levels of randomness can play a role, with the title Order, Disorder and Double Disorder.

Examples are thermal disorder versus quenched disorder such as occurs for example in spin glasses, of stochastic models on random graphs, or random walks in random environments.

The workshop was attended and enjoyed by 35 participants who often had intensive and stimulating discussions, also during the time between and after the lectures.

Three minicourses, each consisting of three lectures, were held by F.V. Jensen (Aalborg) on Bayesian Networks, A. Montanari (Stanford) on Statistical Mechanics on General Graphs, and C.M. Newman and M. Damron (both New York) on Metastates and Applications.

Moreover there were lectures by:

L.P. Arguin (New York) on Ultrametricity in Spin Glasses, N. Berger (Jerusalem) on Random Walk in Random Environment, E. Bolthausen (Zürich) on Spin Glasses, A. Bovier (Bonn) on Metastability in a random model, N. Gantert (Münster) on Biased Random Walks on Trees, O. Häggström (Göteborg) on The contributions of Oded Schramm to Percolation Theory on Nonamenable Graphs, R.W. van der Hofstad (Eindhoven) on First-passage Percolation in Random Graphs, D. Ioffe (Haifa) on Supercritical Percolation, N. Kistler (Bonn) on the Perceptron and Generalized Random Energy Models, V. Sidoravicius (Amsterdam) on Sandpiles and Activated Random Walks, F. Takens (Groningen) on Historic Behaviour.

#### **Sponsors:**

Netherlands Organization for Scientific Research (NWO), Royal Netherlands Academy of Arts and Sciences (KNAW), NSF-Partnerships for International Research and Education (PIRE), the mathematics cluster NWO-Nonlinear Dynamics of Natural Systems (NDSN+).

**October 5-7, 2009 (SIM)**

**YES-III (Young European Statisticians) - Paradigms of Model Choice**

#### **Organizers:**

Laurie Davies, University of Duisburg-Essen, Eindhoven University of Technology, EURANDOM, Geurt Jongbloed, University of Technology, Delft

#### **Participants: 33**

The goal of the workshop was to acquaint young researchers (PhD's and PD's) with different paradigms of model choice. Virtually every statistical analysis is based on a stochastic model for the data so that the choice of model has a direct influence on the results of the analysis. There are many different schools of thought as to how to choose one or more models for a given data set. Apart from important but pragmatic considerations such as computability, the choice of model depends on certain epistemological principles which differ from school to school.

There were four invited speakers Laurie Davies (Approximation), Peter Grünwald (Minimum Description Length), Nils Hjort (Focussed Information Criterion) and Christian Robert (Computational Approaches to Bayesian Model Choice). Unfortunately Peter Grünwald was taken ill after his first talk and was unable to participate in the remainder of the workshop. The remaining three invited speakers gave three 45 minute talks on their different approaches to model choice. These were interspersed by 11 talks each of 20 minutes given by other participants. The topics included circular deconvolution, variable selection for the high dimensional Cox model and the estimation of human dose response curves.

To compensate for the absence of the talks by Peter Grünwald there were discussions at the end of each morning and afternoon session rather than at the end of each day as initially planned. The discussions were lively, interesting, at times times controversial but always held in a friendly atmosphere. The last discussion was particularly successful as the participants were then able to pose more informed questions and give more informed criticisms of the different paradigms of model choice.

There were 33 participants (23 men, 10 women) who came from seven European countries: Belgium, France, Germany, Holland, Italy, Norway and Switzerland.

#### **Sponsors:**

Eindhoven University of Technology, Netherlands Organization for Scientific Research (NWO), Thomas Stieltjes Institute for Mathematics, Eindhoven University of Technology.

**October 29 & 30, 2009**  
**Asset Backed Securities (venue: EIB, Luxembourg)**

**Organizers**

Guido Bichisao, European Investment Bank  
Henrik Jönsson, EURANDOM  
Wim Schoutens, K.U. Leuven & EURANDOM  
Karsten Sundermann, European Investment Bank

**Participants: 88**

A two day conference on securitization and asset-backed securities "Pricing and valuation of ABSs" was held at the European Investment Bank in Luxembourg, October 29 and 30, 2009, with 14 speakers from industry and academia. The conference attracted more than 80 participants from both industry and academia and can be viewed as a very successful event.

The content of the first day was four longer (45 minutes) presentations on regulatory initiatives, rating methodology and valuation of ABSs. Marco Angheben, ESF, presented the most recent discussions with IOSCO, CESR, the European Commission and other regulators, central banks and policy makers surrounding the improvement of the current infrastructure for post-trade transparency. It also described the industry initiatives aimed at improving valuations, price discovery and transparency overall for structured finance products.

Representatives from two of the major rating agencies, Moody's and Standard and Poor's, gave their views on the rating and valuation of ABSs. Benedicte Pfister (Moody's) introduced Moody's ABS rating methodology and models and presented in more detail the agency's rating methodology for SME ABSs. The speaker also described how they have introduced measures (V score and Parameter sensitivity) to improve the reporting of the ratings sensitivity to underlying assumptions to investors. Peter Jones and James West (Standard and Poor's) presented different valuation approaches in use at the present and the challenges to valuation that currently exist, i.e. data, analytic and cashflow requirements. Through a valuation assumption survey, where Standard and Poor's asked market participants on their use of methods, models and assumptions for ABS valuation, the agency tries to create transparency of input assumptions used. The talk ended with a case study where the input assumption found in the survey was used to value an existing ABS deal.

Laila Kollmorgen and Luke Mellor from Forseti Capital gave their view on mark to valuation techniques in an uncertain market. In the talk, the speakers compared the advantages and disadvantages of over-the-counter platforms and bespoke cashflow models and when it is appropriate to use the different approaches. The availability and quality of new issue and ongoing rep line data together with examples of good and not-so-good trustee reports as well as the valuation issues of credit dependent counterparties and their effects on the deal and how to determine the new levels of stressing was also touched upon during the presentation.

The first day ended with a round table discussion chaired by Eric Péree, Chief Economist at EIB, and with a panel consisting of Anneli Peshkoff, Director Treasury, EIB; Wim Schoutens, Prof. Dr., KU Leuven & EURANDOM; Fabrice Susini, Board Member of ESF & Member of EFR; Michel Stubbe, Head of division Market Operations & Analysis, ECB; and Frederico Galizia, Head of Risk Management, EIF.

The second day of the conference was devoted to nine 30 minutes talk. The first two talks in the morning were presented by non-industry participants, Henrik Jönsson (EURANDOM) and Jessica Cariboni (EC Joint Research Center). Henrik Jönsson discussed model risk and parameter uncertainty in the assessment of ABSs. Model risk refers to the fact that the outcome of the assessment of ABSs depends on which quantitative model is used to derive, for example, defaults in the asset pool backing the ABSs. The uncertainties in the parameters used as input to these models add to the uncertainty of the output of the assessment. The significance the model choice and parameter values have on the assessment of ABSs was shown in different examples.

Quantitative sensitivity analysis as a tool for handling model choice and parameter sensitivity was presented by Jessica Cariboni. Jessica gave an introduction to quantitative sensitivity analysis and showed how sensitivity analysis can be used to assess the contributions of the inputs to the total uncertainty of the outcome of an analysis.

The rest of the day contained presentations by representatives from different practitioner experts in the field. Let us mention two of these presentations, the one by Martin Scheicher, ECB, and Joao Garcia, Dexia. Martin Scheicher presented a research study on the pricing of subprime mortgage risk in good times and in bad, describing the use of regression analysis to establish the relationship between observed index returns and macroeconomic news as well as market-based proxies of default risk, interest rates, liquidity and risk appetite. Joao Garcia gave a colorful and dynamic presentation where he

shared his insights on securitization, distressed assets and dynamic credit portfolio management that he has gained over the years and that he has recently published in a book. He covered three topics: pricing distressed assets; managing portfolios of securitization instruments; and correlation, capital costs and the rule of securitization.

**Sponsor:**

European Investment Bank

**October 29-30, 2009**

**Stochastic models for warehousing systems**

**Organizers:**

Ivo Adan, Eindhoven University of Technology, University of Amsterdam

Pascal Etman, Eindhoven University of Technology

René de Koster, Rotterdam School of Management, Erasmus University

The workshop topic: Warehousing has received a growing interest among academics in the last decades. This interest has been strongly stimulated by the rise of complex systems such as automated storage and retrieval systems, sorters, and automated guided vehicles, requiring complex design, and operating policy decisions. Recently, interest has arisen for problems in warehouse layouting, order scheduling and batching, product storage allocation and worker routing, worker congestion, and worker modelling in general, in different warehousing systems and environments. Several models have proven their value in practical operations and decision making. The objective of this workshop is to give an overview of recent research in warehousing with an emphasis on stochastic modelling.

The workshop consisted of 3 keynote lectures and 13 invited lectures. The keynote speakers were: Sunderesh Heragu (University of Louisville, USA), René de Koster (Erasmus University Rotterdam, The Netherlands), Ben Montreuil (Laval University, CA); and the invited speakers were: Ricky Andriansyah (Eindhoven University of Technology, The Netherlands), Kai Furmans (Universität Karlsruhe, D), Jeremie Gallien (Massachusetts Institute of Technology, USA), Yeming Gong (Erasmus University Rotterdam, The Netherlands), Roelof Hamberg (ESI, The Netherlands), Ananth Krishnamurthy (University of Wisconsin-Madison, USA), Liqiang Liu (EURANDOM), José Antonio Larco Martinelli (Erasmus University Rotterdam, The Netherlands), Kees Jan Roodbergen (Erasmus Universiteit Rotterdam, The Netherlands), Maria Vlasidou (Eindhoven University of Technology, The Netherlands), Bruno van Wijnngaarden (Vanderlande, The Netherlands), Yugang Yu (Erasmus Universiteit Rotterdam, The Netherlands).

The meeting was very successful, with many high quality presentations and much discussion, and with participants both from academia and industry. The idea is to continue to organize workshops on warehousing on a more regular basis.

**Participants: 51**

**Sponsors:**

TU/e research cluster Logistics, Operations, and their Information Systems (LOIS), Netherlands Research School on Transport, Infrastructure and Logistics (TRAIL), BMW T

**November 19-21, 2009 (QPA)**

**YEQT-III (Young European Queueing Theorists) Scheduling and Resource Sharing in Queueing Networks**

**Organizers:**

Urtzi Ayesta, Basque Center for Applied Mathematics, Bilbao, Spain and LAAS-CNRS, France

Yoni Nazarathy, EURANDOM

Adam Wierman, California Institute of Technology

**Participants: 52**

This was the third annual Young European Queueing Theorists (YEQT) workshop held at EURANDOM. The goal of this workshop was to bring together young researchers working in the field of queueing and scheduling theory with the aim of helping the young researchers to establish a community. The scope of the current workshop was "Scheduling and Resource Sharing in Queueing Networks" and towards its end the workshop facilitated 16 invited talks by top young researchers, taking 30 minutes each, two one hour key note talks by prominent researchers in the field, and two 2-hour tutorials by



experts.

The list of invited young speakers was primarily composed of young assistant professors and PhD's, but two promising PhD's were also invited to talk. Additionally, most European nationalities were represented among the speakers. The workshop was broadly attended: beyond the speakers and organizers an additional 32 participants joined the workshop, including not just local Dutch researchers, but also prominent researchers and PhD's from countries such as the U.K., France, Belgium, Finland, and Japan.

The methodologies, applications and results presented in the talks were of wide variety, but all were quite focused on resource allocation and scheduling in stochastic settings. The majority of the research work that was presented was related to applications in communication networks, but other application areas such as call-center management, inventory systems, and epidemic control were also discussed. Additionally, a wide variety of methodologies was discussed, including dynamic programming, fluid limits, diffusion approximations, random graph theory, combinatorial optimization, large deviations and game-theory. Many of the participants also stayed after the workshop to attend the NET-COOP conference, which also took place at EURANDOM.

#### **Sponsors:**

Eindhoven University of Technology

**November 23-25, 2010 (QPA)**

**NET-COOP**

#### **Organizers:**

Sem Borst, Eindhoven University of Technology and Alcatel-Lucent Bell Labs  
Onno Boxma, EURANDOM and Eindhoven University of Technology

**Participants: 59**

The NET-COOP 2009 conference took place at EURANDOM, in conjunction with the Euro-NF workshop on "New Trends in Modeling, Quantitative Methods and Measurements".

This year's NET-COOP conference was the third in line, after earlier editions in Avignon in 2007 and Paris in 2008.

The conference focuses on mathematical models and techniques for performance analysis, control and optimization of communication networks.

The technical program consisted of eight sessions on a variety of themes, ranging from 'distributed control' and 'wireless communications' to 'performance analysis methods' and 'queueing analysis', with a mixture of contributed talks and invited presentations.

The program committee, co-chaired by Jacques Resing (TU/e) and Rudesindo Núñez-Queija (UvA & CWI), conducted thorough reviews of all submitted papers, and selected 17 contributions for presentation at the conference.

After careful consideration by an independent committee of international experts, the best-student paper award was presented to Piotr Zuraniewski (AGH University of Science & Technology) for the paper entitled "A Queueing-Based Approach to Overload Detection", co-authored with Michel Mandjes (UvA, EURANDOM & CWI).

In addition, Ivo Adan (EURANDOM, TU/e & UvA), Rob van der Mei (CWI & VU) and Bert Zwart (CWI & VU) assembled an excellent invited-speakers program featuring talks by eight top researchers: Eitan Altman (INRIA Sophia Antipolis & Univ. of Avignon), Rami Atar (Technion), Hans van den Berg (TNO-ICT & UT), Costas Courcoubetis (Athens Univ. of Economics & Business), Mor Harchol-Balter (CMU), Philippe Robert (INRIA Rocquencourt), Devavrat Shah (MIT) and Damon Wischik (UCL). The conference attracted participants from all over the world, and triggered lively discussions and technical exchanges.

#### **Sponsors:**

J.W. Cohen Foundation, Network of Excellence – Euro-NF

**December 14-18, 2010**

**Dynamic Random Environment**

#### **Organizers:**

Frank den Hollander, Mathematisch instituut, Universiteit Leiden, EURANDOM  
Vladas Sidoravicius, CWI, EURANDOM



## Participants: 56

Dynamic random environments is a relatively recent research area that currently undergoes substantial development. The subject of study here are microscopic processes in the systems with underlying disorder that, in turn, evolves in time. Examples of such systems come from physics, chemistry and computer science. The presence dynamics in random environment gives rise to new interesting phenomena. Mathematically, it is a very challenging area.

The workshop brought together a number of leading international researchers in the area, so the participants profited from the overview picture that arose from the talks during the workshop. Mathematical progress in the area occurs at the interface, where, in particular, probability, combinatorics, analysis and geometry meet. Particular themes that were addressed during the workshop include analytical models, population genetics, random networks, metastability, random polymers and spin glasses. Some of these areas are developed more than the others. The workshop gave the opportunity to correct this disbalance and, in particular, for researchers from different backgrounds to learn from each other's achievements. The program was fairly dense, but also between and after the talks there was an intensive discussion. Given the rapid development the research area is currently experiencing, it seems appropriate to organize a follow-up meeting in 3-4 years.

### Sponsors:

Netherlands Organization for Scientific Research (NWO), Royal Netherlands Academy of Arts and Sciences (KNAW), NSF-Partnerships for International Research and Education (PIRE-Partnership for International Research and Education)

QPA-MVR	6
RSS	3
SIM	4
General	0
Total	<u>13</u>

**Total number of participants: 620.**

## Lectures and Seminars

### December

December 9, 2009 (SIM)

Informal meeting Eindhoven statisticians

Shota Gugushvili, EURANDOM

Nonparametric inference for discretely sampled Lévy processes

December 7, 2009 (Chair))

Public Lecture EURANDOM

Dilip Madan, Robert H. Smith School of Business, University of Maryland College Park, USA

Capital Requirements, Acceptable Risks and Profits

December 3, 2009 (RSS)

Jesse Goodman, University British Columbia

Exponential growth of ponds in invasion percolation on regular trees

December 2, 2009 (SIM)

Informal meeting Eindhoven statisticians

### November

November 25, 2009 (SIM)

Informal meeting Eindhoven statisticians

November 18, 2009 (QPA)

Adam Wierman, Caltech, USA

Scheduling to balance energy and delay

November 11, 2009 (SIM)

Informal meeting Eindhoven statisticians

Yoichi Nishiyama, Osaka University

Asymptotic theory of semiparametric Z-estimators for stochastic processes with applications to ergodic diffusions and time series

November 10, 2009 (EPPS)

Mitja Stadje, EURANDOM

Some glimpses of my life

November 5, 2009 (RSS)

Sander Dommers, Eindhoven University of Technology

Ising models on power-law random graphs

November 4, 2009 (SIM)

Informal meeting Eindhoven statisticians

Michiel Hochstenbach, TU/e, Centre for Analysis, Scientific Computing and Applications

Combining probability, statistics, and numerical methods: A probabilistic eigenvalue bound and several open questions

### October

October 27, 2009 (EPPS)

Paulo De Andrade Serra, EURANDOM

Forecasting, Fuzzy Inference Systems and M-Estimation

October 14, 2009 (SIM)

Informal meeting Eindhoven statisticians

Eduard Belitser, EURANDOM & UU

On oracle projection posterior rate and model selection

October 13, 2009 (EPPS)

Ahmad Al Hanbali, EURANDOM

Queueing Models for Wireless Networks

October 9, 2009 (RSS)  
Marcelo R. Hilário, from IMPA - Rio de Janeiro, Brazil  
Fixation for Distributed Clustering Processes

## **September**

September 25, 2009 (RSS)  
Eli Aidekon, Paris University Six  
Random walks in random environment on trees

September 23, 2009 (SIM)  
Informal meeting Eindhoven statisticians  
Haralambie Leahu, TU/e  
Stochastic Gradient Estimation via Measure-Valued Differentiation (MVD)

September 22, 2009 (QPA)  
Bo Zhang, Georgia Institute of Technology  
Refining square-root staffing for the Erlang A model

September 17, 2009 Lois-lecture (III)  
Carlos Daganzo, UC Berkeley  
Adaptive Control of Urban Transportation Systems

September 15, 2009 (EPPS)  
Yoni Nazarathy, EURANDOM  
Interactive demonstrations with MATHEMATICA

September 9, 2009 (SIM)  
Informal meeting Eindhoven statisticians  
Toon Calders, TU/e – Department of Mathematics & Computer Science

## **August**

### **July**

July 20, 2009 (RSS)  
Bas Goorden, Eindhoven Technical University  
Once-reinforced random walks

### **June**

June 30, 2009 (QPA)  
Ger Koole, VU University Amsterdam  
Customer behavior in service systems: why real queues are stable

June 30, 2009, 10.00-11.00 h., LG 1.105 (QPA)  
Problem session  
Ivo Adan, Job dispatching for straddle carriers  
Yoni Nazarathy, Some problems related to the covariance structure of single server queues

June 24, 2009 LOIS Lecture (II)  
L. Green, Columbia Business School  
Using Operations Research to Reduce Delays for Healthcare

June 24, 2009 (SIM)  
Informal meeting Eindhoven statisticians  
René de Jonge

June 18, 2009 (QPA)  
H. Timmermans, Eindhoven University of Technology  
Models of Travel Patterns

June 17, 2009 (SIM)  
Informal meeting Eindhoven statisticians

June 16, 2009 (EPPS)  
Yoav Kerner, EURANDOM  
Some invariance properties of monotone failure rate in the M/G/1 queue

June 16 & 18, 2009 (QPA)  
Reading Seminar

June 11, 2009 (QPA)  
Teunis J. Ott  
Mathematical Analysis of Transport Protocols

## **May**

May 29, 2009 (RSS)  
Robert Fitzner, Eindhoven University of Technology  
A central limiting theorem for memory walks

May 29, 2009 (MRM)  
Andrea Krajina, Universiteit van Tilburg  
An M-Estimator of Tail Dependence in Arbitrary Dimensions

May 29, 2009 (MRM)  
Alexander Herbertsson, department of Economics/Centre for finance School of Business, Economics and Law at the University of Gothenburg, Sweden  
Default contagion in large homogeneous portfolios

May 27, 2009 (SIM)  
Informal meeting Eindhoven statisticians

May 26, 2009 (EPPS)  
Robert Fitzner, Eindhoven University of Technology  
A simple introduction to finance mathematics

May 15, 2009 (General)  
Kick-off meeting STAR

May 7, 2009 (QPA)  
Slawomir Stanczak, Technical University Berlin and Fraunhofer German-Sino Lab for Mobile Communications, Berlin  
Towards Efficient and Fair Resource Allocation in Wireless Networks

May 7, 2009 (QPA)  
Patrick Thiran, EPFL, Switzerland  
Percolation Theory and Scaling Laws for Wireless Networks

## **April**

April 24, 2009 (RSS)  
Bernardo Nunez Borges de Lima, Universidade Federal de Minas Gerais, Brazil  
Percolation of words on  $\mathbb{Z}^d$  with long range connections

April 22, 2009 (SIM)  
Informal meeting Eindhoven statisticians

April 21, 2009 (EPPS)  
Artem Sapozhnikov, EURANDOM  
Invasion percolation in two dimensions

April 16, 2009 (QPA)  
Problem session

April 9, 2009 (QPA)  
Reading Seminar

April 8, 2009 (SIM)  
Informal meeting Eindhoven statisticians

April 7, 2009 (QPA)  
David A. Goldberg, Operations Research Center, MIT, USA  
On the Transient M/M/n Queue in the Halfin-Whitt Regime

## **March**

March 30, 2009 (RSS)  
Anthony Metcalfe, Institut Mittag-Leffler, Sweden  
Structural and universality properties of Gelfand-Tsetlin patterns and their generalizations

March 26, 2009 (QPA)  
Bert Zwart, VU University, CWI Amsterdam  
Competitive scheduling in a large deviations setting

March 24, 2009 (QPA)  
Seva Shneer, EURANDOM  
Heavy-traffic analysis of the maximum of an asymptotically stable random walk

March 20, 2009 (QPA)  
Rüdiger Schultz, University of Duisburg-Essen  
Two-Stage Mixed-Integer Linear Programming Under Stochastic Uncertainty

March 19, 2009 (QPA)  
Reading Seminar

March 18, 2009 (SIM)  
Informal meeting Eindhoven statisticians

March 11. 2009 (SIM)  
Informal meeting Eindhoven statisticians

March 11 - 17 - 20, 2009 (Chair)  
LECTURE SERIES by EURANDOM Chair, Professor Anton Bovier,  
Institut für Angewandte Mathematik. Rheinische Friedrich -Wilhelms-Universität *Bonn*  
Ageing: from trap models to spin glasses

March 10, 2009 (EPPS)  
Mikhail Langovoy, EURANDOM  
Image analyses and percolation theory

March 9 and 11, 2009 (QPA)  
Reuven Rubinstein, Faculty of Industrial Engineering and Technion, Israel Institute of Technology, Haifa, Israel  
Mini-course on "Randomized Algorithms for Counting, Rare-Events Estimation and Optimization"

March 4, 2009 (SIM)  
Informal meeting Eindhoven statisticians

March 3, 2009 (Chair)  
PUBLIC LECTURE by EURANDOM Chair Professor Anton Bovier,  
Institut für Angewandte Mathematik. Rheinische Friedrich -Wilhelms-Universität Bonn  
Metastability-everywhere

March 3, 2009 (QPA)  
Moshe Haviv, Hebrew University of Jerusalem, Department of Statistics  
Strategic behavior in queues

## **February**

February 27, 2009 (RSS)  
Alessandra Bianchi, WIAS Berlin  
Coupling in potential wells: from average to pointwise estimates of metastable times

February 26, 2009 (QPA)  
Reading Seminar

February 25, 2009 (SIM)  
Informal meeting Eindhoven statisticians

February 19, 2009 (QPA)  
Michel Mandjes, Korteweg-de Vries Institute for Mathematics, University of Amsterdam & CWI, Amsterdam & EURANDOM, Eindhoven  
Resource dimensioning through buffer sampling

February 18, 2009 (SIM)  
Informal meeting Eindhoven statisticians

February 17, 2009 (EPPS)  
Alexander Lyedovskykh, EURANDOM  
Modeling of hydrogen storage in hydride-forming materials

February 13, 2009 (RSS)  
Francesca Nardi, Eindhoven University of Technology  
Competitive nucleation in reversible probabilistic cellular Automata

February 12, 2009 (QPA)  
Reading Seminar

February 10, 2009 (QPA)  
Tomasz Rolski, Mathematical Institute, University of Wroclaw  
Exact asymptotics for a Lévy-driven tandem queue with an intermediate input

February 4, 2009 (SIM)  
Informal meeting Eindhoven statisticians

February 3, 2009 (MRM)  
Mitja Stadje, Department of Operations Research & Financial Engineering, Princeton University,  
Stochastic Calculus and Dynamic Risk Measures

February 2, 2009 (RSS)  
Sander Dommers, Eindhoven University of Technology  
Distances in power-law random graphs

## **January**

January 30, 2009 (RSS)  
David Windisch, ETHZ, Zurich, Switzerland  
Convergence of random walk trajectories to random interlacements

January 28, 2009 (SIM)  
Informal meeting Eindhoven statisticians

January 27, 2009 (EPPS)  
Brian Fralix (EURANDOM)  
Some new insights on the transient behavior of pre-emptive queueing models

January 22, 2009 (QPA)  
Reading Seminar

January 14, 2009 (SIM)  
Informal meeting Eindhoven statisticians

January 12, 2009 1st LOIS Lecture  
Prof. Sean Meyn, Chicago, Urbana Champaign  
Dynamics of Prices in Electric Power Networks

January 8, 2009 (QPA)  
Ohad Perry, Columbia University, USA  
A routing policy for the X call-center model designed to respond to unexpected overloads

January 8, 2009 (QPA)  
Yoni Nazarathy, University of Haifa, Israel  
On the variance curve of outputs of some queues and networks

In 2009 EURANDOM organized the following seminar series: 78

**Queueing and Performance Analysis (QPA): 30**

QPA seminar: 18

QPA-MVR seminar: 3

Reading Seminar: 7

Problem session: 2

LOIS lectures: 3

**Random Spatial Structures (RSS): 12**

**Statistical Information and Modelling (SIM): 21**

Informal meetings Eindhoven statisticians: 21

**General: 15**

EURANDOM Postdoc and PhD seminar (EPPS): 10

Lectures by the EURANDOM Chair: 5

## EURANDOM visitors in 2009

<b>January</b>		
Y. Nazarathy (Netvision, IL)	January 4 - 11	QPA
O. Perry (Columbia University, USA)	January 5 - 10	QPA
<b>February</b>		
T. Rolski (Wroclaw University, P)	February 3 - March 1	QPA
P. Klusik (University of Wroclaw, P)	February 22 - 25	QPA
R. Rubinstein (Technion, IL)	February 26 - March 16	QPA
A. Bianchi (WIAS, D)	February 15 - 28	RSS
A. Bovier (Rheinische Friedrich-Wilhelms-Universität Bonn, D)	February 15 - March 28	EUR CHAIR
<b>March</b>		
M. Haviv ( Hebrew University of Jerusalem, IL)	March 1 - 5	QPA
N. Kistler (Rheinische Friedrich-Wilhelms-Universität Bonn, D)	March 10 - 12	RSS
B. Prabhu (LAS-CNRS, FR)	March 15 - 19	QPA
U. Yechiali (Tel Aviv University, IL)	March 22 - March 31	QPA
A. Metcalfe (Trinity College Dublin, IE)	March 29 - April 3	RSS
<b>April</b>		
D. Goldberg ( Operations Research Center, MIT, USA)	April 4 - 13	QPA
B. Nunez Borges de Lima (Universidade Federal de Minas Gerais, BR)	April 19 - 28	RSS
P. Thiran (EPFL, Lausanne, CH)	April 26 - May 3	QPA
<b>May</b>		
A. Herbertson (University of Gothenburg, S)	May 11 - June 11	QPA- MVR
<b>June</b>		
A. Busic (Université Paris Diderot, F)	June 12 - July 12	QPA
<b>July</b>		
S. Bar-Lev (University of Haifa, IL)	July 15 - September 15	QPA
O. Kella (Hebrew University of Jerusalem, IL)	July 31 - September 1	QPA
<b>August</b>		
D. Perry (University of Haifa, IL)	August 1 - February 5, 2010	QPA
M. Damron (Princeton University, USA)	August 9 - 15	RSS
M. Luczak (Londen School of Economics, UK)	August 31 - September 4	RSS
<b>September</b>		
E. Aidekon (LPMA, Université Paris VI, F)	September 1 - January 1, 2010	RSS
M. Hilario ( IMPA, BR)	September 9 - December 9 (1 day a week)	SIM
G. Weiss (University of Haifa, IL)	September 16 - October 15	QPA
<b>October</b>		
Z. Palmowski (University of Wroclaw, P)	Oct. 5 - 10, 2009	QPA
<b>November</b>		
T. Hellings (TU/e & CWI, NL)	November 1 - December 31	QPA
Y. Nishiyama (The Institute of Statistical Mathematics, Tokyo, JP)	November 9 - 13	SIM
Y. Kerner (Technion, IL)	November 13 - December 6	QPA



A. Wierman (California Institute of Technology, USA)	November 16 - 21	QPA
M. Romito (Marco; Università Di Firenze, I)	November 22 & 23	QPA
W. Kager (VU, NL)	November 25 - December 4 (2 days)	QPA
	<b>December</b>	
D. Madan ( University of Maryland, College Park, USA)	December 4-13	EUR CHAIR
R. Sun ( National University of Singapore, SG)	December 10-21	RSS

In total 34 researchers visited EURANDOM in 2009 (from several days up to 3 months). Total residence time: 152,8 weeks.

Distribution over the programmes:

Programme	Number of visits	Weeks
QPA, including MVR and Chair	23	112,4
RSS including Chair	9	37
SIM	2	3,4
<b>TOTAL</b>	<b>34</b>	<b>152,8</b>

## EXPENDITURE

The sum of the expenditure is based on the audited financial report.

Expenditure (in K euro)

Staff	1.053
Senior Fellows	76
Travel	40
Visitors	58
Workshops, Seminars	95
Books, Journals, Software	5
Depreciation costs	11
General costs	61
	<hr/>
TOTAL	1399

Furthermore postdocs "In Natura" (168K Euro), visitors (22K Euro) and workshop participants (165K Euro) with their own grants form an essential part of the EURANDOM activities. Based on average cost estimates this contribution "in natura" represented this year a money value of 355 K Euro.