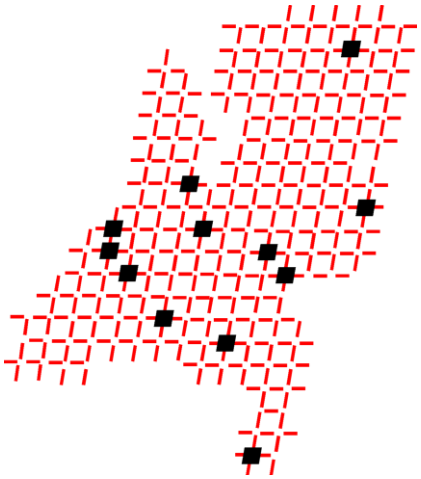

DUTCH NETWORK ON THE MATHEMATICS OF OPERATIONS RESEARCH (LNMB)

MASTER AND PhD PROGRAMME IN OPERATIONS RESEARCH

Information Guide 2013/2014

June 2013

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Preface

The education programme of the LNMB provides high quality teaching in the broad field of interest in the mathematics of operations research, including new interesting areas. The programme consists of 27 courses for Master and PhD students. This year seven Master courses and nine PhD courses are scheduled (the PhD courses have a cycle of two years). It is allowed that Master students attend PhD courses and, vice versa, that PhD students attend Master courses. The lectures are taught in the Uithof buildings of the Utrecht University.

The education programme for the academic year 2013/2014 consists of the following courses.

Master courses:
Fall 2013:
− Introduction to Stochastic Processes;
– Continuous Optimization;
– Discrete Optimization;
– Heuristic Methods in Operations Research.
Spring 2014:
– Advanced linear programming;
– Scheduling;
– Queueing theory.

PhD courses:
Trimester 1:
– Markov Decision Processes;
– Algorithms and Complexity;
– Interior Point Methods.
Trimester 2:
− Integer Programming Methods;
− Noncooperative Games;
− Inventory Management in Supply Chains.
Trimester 3:
− Operations Research and Health Care;
− Algorithmic Game Theory;
− Advanced Topics in Stochastic Operations Research;
− Stochastic Programming.

Besides information about the LNMB courses, this guide contains:
− Organizational and administrative affairs;
− Information about the operations research groups at the Dutch universities;
− Lists of members, PhD students and alumni.

The information is also available via the LNMB website www.lnmb.nl

In addition to the courses, the LNMB organizes the 39th Lunteren Conference on the Mathematics of Operations Research. This conference will be held 14 - 16th January 2014.

The LNMB gladly acknowledges the financial support by the universities. This enables the LNMB to continue its activities.

Johann Hurink,
Scientific director LNMB
June, 2013

1. Dutch Network on the Mathematics of Operations Research (LNMB)

The Dutch Network on the Mathematics of Operations Research (in Dutch: Landelijk Netwerk Mathematische Besliskunde; abbreviated LNMB) is an interuniversity co-operation in which all Dutch universities and the Centre for Mathematics and Computer Science (CWI) in Amsterdam participate. The LNMB has been established in July 1987. From 1987 until 2001 the University of Groningen was its administrator, from 2002 until 2006 the University of Maastricht, and from January 2007 the University of Twente acts as administrator of the LNMB.

The tasks of the LNMB are twofold. Firstly, the LNMB offers courses for PhD and Master students, and is responsible for the annual Lunteren Conference on the Mathematics of Operations Research. Secondly, the LNMB is an organization of full and associate professors in the field of Operations Research. The universities and the CWI are represented in the General Board out of whom an Executive Board is chosen.

The LNMB has 118 members and 198 PhD students. The LNMB courses are also accessible, on payment, to other interested people. An independent judgment by NWO (Netherlands Organization for Scientific Research) has proven that the LNMB graduate education programme is of a high international standard.

2. PhD courses and diploma requirements (general information)

The programme of the LNMB PhD courses is offered in a biennial cycle consisting of 20 courses. The subjects of the courses are in the following areas: Combinatorial Optimization, Stochastic Operations Research, Mathematical Programming, Game Theory and Applications of OR.

The programme is flexible in the sense that new PhD students can start with their programme at the beginning of any trimester. Furthermore, the individual programmes can vary; each student can choose his of her own parts of the education programme. In each trimester a combination of various subjects is taught. In general one can follow each of the courses without any prerequisites of the other courses. The courses take place on Monday in Utrecht.

The courses are intended for PhD students in Operations Research. However, Master students in mathematics, econometrics or computer science who acquired enough prerequisites are also welcome. Further information can be obtained from the director of the LNMB or from the lecturers of the courses. Furthermore, government and/or business employees who want to follow a course may participate. Participants are expected to make exercises (homework) during or at the end of the course to show that they have understood the contents of the course. The credits (including for the attendance of the course) for participants who have passed the exercises successfully have been set at 4 EC per course. In case the courses are only attended (or when the exercises are not passed successfully), the workload is set at 1 EC. At the end of each course the participants receive a certificate with the grade and the credits involved.

The following regulation holds for the course fee. Participants from the departments of the Dutch universities which finance the LNMB don't pay any course fee. Other participants pay for each course a fee of 500 Euro. The director of the LNMB is authorized to grant a reduction of this fee at occurring situations.

Application to a LNMB PhD course can be done by filling in the online application form available at the website http://www.lnmb.nl/pages/courses/. PhD students who participate for the first time in LNMB courses, also have to fill in the form for new PhD Students, which can also be found on the mentioned website.

In addition to the courses, the PhD programme includes the Lunteren Conference on the Mathematics of Operations Research. During this conference prominent - usually foreign - researchers lecture on special topics or on recent research. PhD students can give a so-called PhD presentation. In such a presentation one can present his or her research results. It is preferred to give such a presentation in the 2nd or 3rd year of the PhD period. Attendance in the Lunteren Conference is credited by 1 EC.

PhD students who have sufficiently participated in the LNMB PhD programme and have given a PhD presentation will receive a diploma. Here, 'sufficiently' means total credits of 25 EC. Under certain circumstances the supervisor may submit a motivated request to give the diploma to a PhD student although he or she did not meet the requirement of the PhD presentation. After consultation with the director, it is possible that credit points from a related PhD network also count as credit points for the LNMB diploma.

3. Master courses (general information)

From September 2004, the LNMB provides Master courses in Operations Research. These courses are intended for Master students in Mathematics or Econometrics who want to take one or more courses in Operations Research. Usually, the Master thesis adviser will propose or decide that a student will participate in LNMB Master courses.

Due to the small number of Master students in Operations Research at each individual university, a national concentration is efficient and can help to guarantee a qualitatively high education. This is the main purpose of the LNMB Master courses. An additional advantage for the students is the contact with professors and students from other universities. The LNMB Master courses are part of the Dutch Master Programme in Mathematics, which is a coordinated programme of the Departments of Mathematics of the Dutch universities.

In each semester (Fall and Spring) three or four LNMB Master courses are given. The subjects of the courses are taken from the following areas: Mathematical Programming, Combinatorial Optimization and Stochastic Operations Research. The programme is flexible in the sense that new Master students can start with their programme at the beginning of any semester. Furthermore, the individual programmes can vary; each student can choose his of her own courses. The courses take place on Monday in Utrecht.

Although the courses are intended for Master students, PhD students are also welcome. It is up to their thesis adviser to propose or decide that a PhD student will attend such a course. Further information can be obtained from the director of the LNMB.

The students are subjected to an examination that usually will consist of making exercises during the course and also a written or oral examination. The credits for participants who have passed the examination successfully have been set by the LNMB at ***6 EC*** per course. A final decision about the credits and the grade is formally up to the university of the student.

The organisational part of the Master courses is done by the Dutch Master's Degree Programme in Mathematics (Mastermath). Therefore, Master- as wel as PhD students have to register for the Master courses of the LNMB via the website of Mastermath (http://www.mastermath.nl/). Mastermath distribute the results of the Master students to the corresponding universities and the PhD students get a certificate via LNMB.

4. PhD courses 2013/2014

During the academic year 2013/2014 ten courses will be taught in three trimesters; each trimester has a duration of nine weeks. In the 3rd trimester two courses are given in parallel.

Trimester 1: (September 9 – November 4)

– Markov Decision Processes (MDP)	Bhulai/Spieksma	
– Algorithms and Complexity (AC)	Woeginger	
– Interior Point Methods (IPM)	de klerk	

Trimester 2: (November 11 – December 16 & Januari 20 – February 3)

– Integer Programming Methods (IntPM)	Pendavingh	
– Noncooperative Games (NCG)	Thuijsman	
– Inventory Management in Supply Chains (IMSC)	Dekker/van Houtum	

Trimester 3: (February 10 – April 17)

– Operations Research and Health Care (ORHC)	Hans/van de Klundert	
– Algorithmic Game Theory (AGT)	Schäfer	(parallel)
– Advanced Topics in Stochastic Operations Research (ATS)	Zwart	(parallel)
– Stochastic Programming (SP)	van der Vlerk	

The courses are given on Monday according to the following schedule:

	Trimester 1	*Trimester 2*	*Trimester 3*
10.15 – 11.00	Course MDP	Course IntPM*	Course ORHC
11.15 – 12.00	Course MDP	Course IntPM*	Course ORHC
12.00 – 13.00	Lunch break	Lunch break	Lunch break
13.00 – 13.45	Course AC*	Course NCG	Course AGT & ATS
14.00 – 14.45	Course AC*	Course NCG	Course AGT & ATS
15.00 – 15.45	Course IPM	Course IMSC	Course SP
16.00 – 16.45	Course IPM	Course IMSC	Course SP

* = in cooperation with DIAMANT

Location:
The courses are given in the Uithof (buildings of the Utrecht University), in the Mathematical Building, Room 611AB, Budapestlaan, Utrecht; except for one of the courses AGT and ATS (the room will be announced later this year).

Credits:
The credits (including for the attendance of the course) for participants who have passed the exercises successfully are ***4 EC*** per course. In case the courses are only attended (or when the exercises are not passed successfully), then the workload is set at ***1 EC***. At the end of each course the participants receive a *certificate* with the grade and the credits involved.

Registration:
Anyone interested in these courses is invited to fill in the online registration form on the webpage of the LNMB (http://www.lnmb.nl/pages/courses/phdcourses/). For each of the three trimesters a separate form is given. If you are a new PhD student, please also fill in the 'Form for New PhD students' on that webpage.

Course MDP: "Markov Decision Processes"

Time : Monday 10.15 – 12.00 (September 9 – November 4).
Location: Room will be announced later on the LNMB webpage, Utrecht (De Uithof).
Lecturers: Dr. S. Bhulai (VU University) and Dr.ir. F.M. Spieksma (Leiden University).

Course description:
The theory of Markov decision processes (MDP's) - also known under the names sequential decision theory, stochastic control or stochastic dynamic programming - studies sequential optimization of stochastic systems by controlling their transition mechanism over time. Each control policy defines a stochastic process and values of objective functions associated with this process. The goal is to select a control policy that optimizes a function of the values generated by the utility functions.

In real life, decisions that are made usually have two types of impact. Firstly, they cost or save resources, such as money or time. Secondly, by influencing the dynamics of the system they have an impact on the future as well. Therefore, the decision with the largest immediate profit may not be good in view of future rewards in many situations. MDP's model this paradigm and can be used to model many important applications in

practice. In this course we provide results on the structure and existence of good policies, on methods for the computation of optimal policies, and illustrate them by applications.

Detailed content:
– model formulation, policies, optimality criteria, the finite horizon;
– average rewards: optimality equation and solution methods;
– discounted rewards: optimality equation and solution methods;
– structural properties;
– applications of MDP's;
– further topics in MDP's.

Literature:
Lecture notes will be provided.

Prerequisites:
– elementary knowledge of linear programming (e.g. K.G. Murty, Linear programming, Wiley, 1983);
– elementary knowledge of probability theory (e.g. S.M. Ross, A first course in probability, Macmillan, New York, 1976);
– elementary knowledge of (numerical) analysis (e.g. Banach space; contracting mappings; Newton's method; Laurent series).

Examination:
Take home problems.

Addresses of the lecturers:
Dr. S. Bhulai
Department of Mathematics, VU University Amsterdam
De Boelelaan 1081a, 1081 HV Amsterdam
Phone: 020 – 5987679 E-mail: sbhulai@few.vu.nl URL: www.math.vu.nl/~sbhulai

Dr. F.M. Spieksma
Mathematical Institute, Leiden University
P.O. Box 9512, 2300 RA Leiden
Phone: 071 – 5277128 E-mail: spieksma@math.leidenuniv.nl

Course AC: "Algorithms and Complexity"

Time: Monday 13.00 – 14.45 (September 9 – November 4).
Location: Mathematical Building, Room 611AB, Budapestlaan, Utrecht (De Uithof).
Lecturer: Prof.dr. G.J. Woeginger (TU/e).

Course description:
Combinatorial optimization is the investigation of design and planning problems in which discrete decisions must be made. The field originated in the 1950's with the work of Dantzig et al and Gomory on integer linear programming formulations for routing, scheduling and cutting stock problems. Other applications occur, e.g. in facility location, network and circuit design, and biomolecular systems.
The course gives an introduction into NP-hardness, and discusses approaches for dealing with NP-hard problems, like: approximation techniques; local search; fixed parameterized tractability; exact algorithms.

Literature:
– C.H. Papadimitriou, K. Steiglitz, Combinatorial Optimization: Algorithms and Complexity, Dover, 1998;
– in addition, some papers will be provided.

Prerequisites:
– knowledge of basic linear algebra;
– knowledge of network flow, linear programming and duality as, e.g., in V. Chvatal, Linear Programming, Freeman, 1983.

Examination:

Address of the lecturer:
Prof.dr. G.J. Woeginger
Department of Mathematics & Computer Science, Eindhoven University of Technology
P.O. Box 513, 5600 MB Eindhoven
Phone: 040 – 2472415 E-mail: gwoegi@win.tue.nl URL: www.win.tue.nl/~gwoegi

Course IPM: "Interior Point Methods"

Time : Monday 10.15 – 12.00 (September 9 – November 4).
Location: Mathematical Building, Room 611AB, Budapestlaan, Utrecht (De Uithof).
Lecturer: Prof.dr. E. de Klerk (Tilburg University).

Course description:
The field of optimization, particularly linear, convex and semi-definite optimization, has been given a new impulse by the development of interior point methods. Besides the existence of a new theory, there is a tremendous activity in new applications, especially in semi-definite programming.

The topics for this course include:
– interior-point methods for conic programming;
– classical duality theory for conic programming;
– symmetric cones;
– primal-dual interior-point algorithms;
– semidefinite programming.

Literature:
– main course notes (students: please buy or borrow this book before the course starts. If you order the book from Amazon.com, then allow enough time for delivery);
– James Renegar, "A Mathematical View of Interior-Point Methods for Convex Optimization". MPS-SIAM Series on Optimization, Philadelphia (2001);
– additional course notes:
Stephen Boyd and Lieven Vandenberghe. Convex Optimization, Cambridge University Press (2004).
Available online: http://www.stanford.edu/~boyd/cvxbook/.

Prerequisites:
Basic knowledge (bachelor level) of analysis (multivariate calculus) and linear algebra, as well as a first course in linear and nonlinear programming.

Examination:
Take home problems.

Address of the lecturer:
Prof.dr. E. de Klerk
Department of Econometrics & Operations Research, Tilburg University
P.O. Box 90153, 5000 LE Tilburg
Phone: 013 – 4662031 E-mail: edeklerk@tilburguniversity.edu

Course IntPM: "Integer Programming Methods"

Time : Monday 10.15 – 12.00 (November 11 – December 16 & January 20 – February 3).
Location: Mathematical Building, Room 611AB, Budapestlaan, Utrecht (De Uithof).
Lecturer: Dr. R.A. Pendavingh (TU/e).

Course description:
The vast majority of problems in combinatorial optimization can be formulated as an integer linear program (ILP): Maximize or minimize a linear objective function subject to linear constraints and the additional restriction that the decision variables can take only integer values (typically only 0/1). This makes ILP's a perfect tool for formulating problems in combinatorial optimization; many software packages are available for this. The drawback is that solving ILP's is generally a computationally demanding task; it is NP-hard. Nevertheless, in practice, also these problems have to be solved. In this part of the course we focus on techniques for solving ILP's.

The following topics will be treated:
– the expressive power of ILP's in combinatorial optimization;
– geometry of integer linear programs: the interplay of polyhedra and lattices;
– easy and difficult ILP's;
– geometric techniques based on cutting planes;
– algebraic techniques based on lattice basis reduction.

Literature:
– B. Korte, J. Vygen, Combinatorial Optimization, Theory and Algorithms, Springer 2008 (available online via springerlink);
– A. Schrijver, Theory of Linear and Integer Programming, J. Wiley and Sons Ltd., Chichester, 1986.

Prerequisites:
Knowledge of linear algebra.

Examination:
Take home problems.

Address of the lecturer:
Dr. R.A. Pendavingh
Department of Mathematics and Computer Science, Eindhoven University of Technology
P.O. Box 513, 5600 MB Eindhoven
Phone: 040 – 2474235 E-mail: rudi@win.tue.nl

Course NCG: "Noncooperative Games"

Time : Monday 13.00 – 14.45 (November 11 – December 16 & January 20 – February 3).
Location: Mathematical Building, Room 611AB, Budapestlaan, Utrecht (De Uithof).
Lecturer : Dr. F. Thuijsman (Maastricht University).

Course description:
The course will focus on noncooperative games, one-shot as well as dynamic, in the following order: matrix and bimatrix games, repeated games, specific models of stochastic (Markov) games, evolutionary games. We explore solution concepts like "value" and "optimal strategies" for zero sum games and "equilibrium" for non-zero sum games as well as methods to calculate these. In these noncooperative games the players are strategic decision makers, who cannot make binding agreements to achieve their goals.
Instead, threats may be applied to establish stable outcomes. Besides, we explore the concepts of "evolutionary stable strategy" and "replicator dynamics" and their relations with models of population dynamics. For some of these topics we will explore the boundaries of what is presently known and touch upon some challenging prioblems.

Literature:
Lecture notes will be provided.

Prerequisites:
Basic knowledge (bachelor level) of analysis, linear algebra, linear programming and Markov chains.

Examination:
Take home problems.

Address of the lecturer:
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URL: http://dkemaastrichtuniversity.nl/f.thuijsman

Course IMSC: "Inventory Management in Supply Chains"

Time : Monday 15.00 – 16.45 (November 11 – December 16 & Januari 20 – February 3).
Location: Mathematical Building, Room 611AB, Budapestlaan, Utrecht (De Uithof).
Lecturer: Prof.dr.ir. R. Dekker (Erasmus University) and Prof.dr.ir. G.J. van Houtum (TU/e).

Course description:
We discuss for two types of supply chains:
1. supply chains for regular goods;
2. spare parts supply chains.

Supply chains for regular goods consist of production (of components), assembly and distribution stages. We focus on the evaluation and optimization of (s,S) inventory control policies for a single item single stocking point with order and product fill rates, both under normal or gamma distributed demand as well as Poisson

demand processes. Next we discuss coordinated ordering (joint replenishment) of multiple items and customer differentiation.
Spare parts supply chains consist of central depots, local warehouses and repair shops. Demands for spare parts stem from corrective and planned maintenance operations. We focus on chains that provide spare parts for advanced capital goods. Service measures are in terms of system availabilities, and this leads to multi-item, multi-echelon inventory planning problems for the spare parts. We discuss various multi-item inventory models which are relevant to support real-life planning problems.

Literature:
– handouts will be provided during the course;
– some chapters from Axsater, S. "Inventory control", Springer-Verlag.

Prerequisites:
– basic probability theory;
– basic knowledge of Markov processes and queueing theory (M|M|1, M|G|∞, M|G|c|c queue).

Examination:
Two sets of homework exercises.

Addresses of the lecturers:
Prof.dr.ir. R. Dekker
Econometric Institute, Faculty of Economics, Erasmus University Rotterdam
P.O. Box 1738, 3000 DR Rotterdam
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Prof.dr.ir. G.J. van Houtum
Department of Technology Management, Eindhoven University of Technology
P.O. Box 513, 5600 MB Eindhoven
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Course ORHC: "Operations Research and Healthcare"

Time: Monday 10.15 – 12.00 (February 10 – April 7).
Location: Mathematical Building, Room 611AB, Budapestlaan, Utrecht (De Uithof).
Lecturers: Dr.ir. E.W. Hans (University of Twente) and Prof.dr. J.J. van de Klundert (Erasmus University).

Course description:
Global and national developments cause the health of populations and individuals to pose new problems for societies and organizations. As expectations rise and populations age, the burden of health care cost becomes increasingly difficult to carry. Society is presented with tough decision problems regarding the efficient, effective and equitable use of scarce resources to improve our precious health. For many of these problems, operations research provides valuable solution methods.

In this course, we start by overviewing topics, methodology, models, and objectives for health care decision making. We subsequently provide an in depth and rigorous mathematical treatment of operations research applications in a variety of prominent domains. Partly, the material will be based on application of classical operations research methods e.g. from combinatorial optimization or queuing theory) to problems in the domain of health care. Another part of the course addresses health care specific problems and methods, which go beyond classical OR applications.

The course will be organized by topic:
– health services research methodology;
– outpatient planning (Queuing, Scheduling);
– resource Planning & Scheduling (Scheduling, Branch-and-Price, Stochastic Programming);
– human resource planning (Rostering, Crew Scheduling);
– health Chain Planning (Supply Chain Planning, Combinatorial Optimization, Queuing);
– medical decision making (decision making under uncertainty, utility maximization);
– epidemiological models (Markov decision models, sensitivity analysis);
– optimization problems in Quality & Safety (Risk modeling, markets);
– benchmarking (Data Envelopment Analysis, Stochastic Frontier Analysis).

Literature:
Papers/handouts.

Prerequisites:

Understanding of queuing theory and combinatorial optimization at MSc. level.

Examination:
Take home problems (4).

Addresses of the lecturers:
Dr.ir. E.W. Hans
Department of Operational Methods for Production and Logistics, University of Twente
P.O. Box 217, 7500 AE Enschede
Phone: 053 – 4893523 E-mail: e.w.hans@utwente.nl

Prof.dr. J.J. van de Klundert
Erasmus University, Institute of Health Policy & Management
P.O. Box 1738, 3000 DR Rotterdam
Phone: 010 – 4088595 E-mail: vandeklundert@bmg.eur.nl

Course AGT: "Algorithmic Game Theory"

Time : Monday 13.00 – 14.45 (February 10 – April 7).
Location: Mathematical Building, Room 611AB, Budapestlaan, Utrecht (De Uithof).
Lecturer: Prof.dr. G. Schäfer (VU University Amsterdam/CWI).

Course description:
Algorithmic game theory is a rather new and rapidly growing research area that lies at the intersection of mathematics, theoretical computer science and economics. It uses game-theoretical models and solution concepts to study situations of strategic decision making, with a particular focus on computational and algorithmic issues. It combines methodologies and techniques from areas like discrete optimization, algorithms, computational complexity, game theory, mechanism design, etc.
The overall goal of the course is to both learn about fundamental results of the field and to get acquainted with recent state-of-the-art techniques.

Potential topics that will be covered in the course are:
– computation of equilibria (potential function, PPAD-completeness);
– inefficiency of equilibria (price of stability, price of anarchy);
– selfish routing games (non-atomic, atomic, price of anarchy);
– congestion games (potential games, PLS-completeness) ;
– smoothness of games (robust price of anarchy, learning);
– reducing the inefficiency (network tolls, Stackelberg routing);
– combinatorial auctions (first-price, second-price, VCG mechanism);
– approximation and mechanism design (single-minded bidders);
– ad auctions and the generalized second-price auction;
– revenue maximization and the Bayesian setting.

Literature:
– lecture notes will be provided in class;
– most topics that will be covered in the course can be found in the following book:
N. Nisan, T. Roughgarden, E. Tardos, and V.V. Vazirani (Editors), Algorithmic Game Theory, Cambridge University Press, 2007.
Note: The full-text of the book is available online here (username=agt1user, password=camb2agt).

Prerequisites:
– basic knowledge of algorithms, optimization and computational complexity;
– some knowledge of game theory is advantageous.

Examination:
Take home problems.

Address of the lecturer:
Prof.dr. G. Schäfer
CWI, P.O. Box 94079, 1090 GB Amsterdam
Phone: 013 -4662122 E-mail: g.schaefer@cwi.nl

Course ATS: "Advanced Topics in Stochastic Operations Research"

Time : Monday 13.00 – 14.45 (February 10 – April 7).

Location: Mathematical Building, Room 611AB, Budapestlaan, Utrecht (De Uithof).
Lecturer: Prof.dr. A.P. Zwart (CWI).

Course description:
course topics: control of complex stochastic networks.
Designing and managing complex networks arising in road traffic, power grids and communications require a set of tools at the interface of stochastics and optimization. This course aims to give an overview of such techniques. We investigate properties of several classes of (abstract versions of) algorithms used in practice. Keywords: workload models, learning, distributed control, stabilizing stochastic systems. Applications to manufacturing, energy, wireless and road traffic networks.

Literature:
Sean Meyn - Control techniques for complex networks and handouts provided during the course.

Prerequisites:
A solid background in stochastic OR, and to a lesser extent optimization and convex analysis, is desired.

Examination:
Take home problems.

Address of the lecturer:
Prof.dr. A.P. Zwart
ST (Stochastics), CWI
P.O. Box 94079, 1090 GB Amsterdam
Phone: 020 – 5924089 E-mail: bert.zwart@cwi.nl

Course SP: "Stochastic Programming"

Time: Monday 15.00 – 16.45 (February 10 – April 7).
Location: Mathematical Building, Room 611AB, Budapestlaan, Utrecht (De Uithof).
Lecturers: Prof.dr. M.H. van der Vlerk (University of Groningen).

Course description:
Stochastic programming (see also http://stoprog.org) is a framework for modelling optimization problems that involve uncertainty. Whereas deterministic optimization problems are formulated with known parameters, real world problems almost invariably include some unknown parameters. When the parameters are known only within certain bounds, one approach to tackling such problems is called robust optimization. Here the goal is to find a solution which is feasible for all such data and optimal in some sense. Stochastic programming models are similar in style but take advantage of the fact that probability distributions governing the data are known or can be estimated. The goal here is to find some policy that is feasible for all (or almost all) the possible data instances and maximizes the expectation of some function of the decisions and the random variables. More generally, such models are formulated, solved analytically or numerically, and analyzed in order to provide useful information to a decision-maker.

The most widely applied and studied stochastic programming models are two-stage linear programs. Here the decision maker takes some action in the first stage, after which a random event occurs affecting the outcome of the first-stage decision. A recourse decision can then be made in the second stage that compensates for any bad effects that might have been experienced as a result of the first-stage decision. The optimal policy from such a model is a single first-stage policy and a collection of recourse decisions (a decision rule) defining which second-stage action should be taken in response to each random outcome.

The following subjects are discussed:
– concepts and examples of stochastic programming;
– stochastic linear programming;
– recourse models;
– chance constraints;
– SP calculus (e.g. convexity; approximation of distributions);
– algorithms;
– stochastic integer programming;
– multi-stadia recourse models;
– case study.

Literature:
Lecture notes will be provided.
Indication for the level:
– J.R. Birge and F. Louveaux, Introduction to stochastic programming, Springer, 1997;

– P. Kall and S.W. Wallace, Stochastic programming, Wiley-Interscience Series in System and Optimization, 1994.

Prerequisites:
– basic knowledge of probability theory: S.M. Ross, Introduction to probability models, 8th edition, Academic Press, 2003 (chapters 1-3);
– basic knowledge of linear programming: V. Chvatal, Linear programming, Freeman, 1983.

Examination:
Take home problems, case study.

Address of the lecturer:
Prof.dr. M.H. van der Vlerk
Department of Operations, University of Groningen
P.O. Box 800, 9700 AV Groningen
Phone: 050 – 3633816 E-mail: m.h.van.der.vlerk@rug.nl

5. Master courses 2013/2014

During the academic year 2013/2014 seven courses will be taught in two semesters; each semester has a duration of 12 weeks. The courses are part of the Dutch Master Programme in Mathematics (http://www.mastermath.nl).

Fall 2013:
– ISP (Introduction to stochastic processes; September 9, 10, 16 and 17);
– CO (Continuous optimization; September 23 – December 9);
– DO (Discrete optimization; September 23 – December 9);
– HEU (Heuristic Methods in Operations Research; September 23 – December 9).

Spring 2014 (Febuary 3 – April 14, April 28):
– ALP (Advanced linear programming);
– SCH (Scheduling);
– QT (Queueing theory).

The courses are given on Monday according to the following schedule:

	*Fall 2013**	*Spring 2014*
11.00 – 11.45	Course CO/DO	Course ALP**
12.00 – 12.45	Course CO/DO	Course ALP**
12.45 – 13.15	Lunch break	Lunch break
13.15 – 14.00	Course CO/DO	Course SCH
14.15 – 15.00	Course CO/DO	Course SCH
15.15 – 16.00	Course HEU	Course QT
16.15 – 17.00	Course HEU	Course QT

* The course ISP is thaught on September 9, 10, 16 and 17 (10.15 – 12.00 and 13.00 – 14.45 each day).
** In cooperation with DIAMANT

Location:
The courses are given in the Uithof (buildings of the Utrecht University). Detailed information on the location can be found on the website of the Dutch Master Programme in Mathematics (Masthermath): http://www.mastermath.nl/locations.

Credits:
The credits for students who have passed the exercises successfully are 6 EC per course, except the short course ISP (4 EC).

Detailed information about the courses:
The registration and administration of the master courses is done by the Dutch Master Programme in Mathematics.
Anyone interested in these courses is invited to register via http://www.mastermath.nl.

Course ISP: "Introduction to Stochastic Processes"

Time : 10.15 – 12.00 and 13.00 – 14.45 (September 9, 10, 16 and 17).
Location: Utrecht (De Uithof).
Lecturers: Dr. N. Litvak (University of Twente) and Dr.ir. W.R.W. Scheinhardt (University of Twente).

Aim:
To provide an introduction in the basic notions of stochastic processes as applied in stochastic operations research topics like queueing theory and Markov decision processes.

Description:
The following subjects will be treated:
– discrete time Markov chains, including classification of states and long run behaviour and branching processes;
– exponential distribution and Poisson Processes;
– generating functions and Laplace-Stieltjes transforms;
– continuous time Markov chains and birth-and-death processes;
– renewal theory, including renewal theorem, renewal reward processes and regenerative processes.

Literature:
S.M. Ross, "Introduction to probability models", 10th edition, Academic Press, 2010.
The 9th or 8th edition can also be used. Having the book is essential for the course.

Examination:
Written examination.

Prerequisities:
Knowledge of probability at the level: S.M. Ross, 'Introduction to probability models', 10th edition, Academic Press, 2010 (chapters 1-3).

Addresses of the lecturers:
Dr. N. Litvak
Department of Applied Mathematics, University of Twente
P.O. Box 217, 7500 AE Enschede
Phone: 053-4893338 E-mail: n.litvak@utwente.nl

Dr.ir. W.R.W. Scheinhardt
Department of Applied Mathematics, University of Twente
P.O. Box 217, 7500 AE Enschede
Phone: 053-4893832 E-mail: w.r.w.scheinhardt@utwente.nl

Course CO: "Continuous Optimization"

Time : Monday 11.00 – 12.45 (September 23 – December 9).
Location: Utrecht (De Uithof).
Lecturer: Dr. J.C. Vera (Tilburg University).

Aim:
The course aims to provide an advanced introduction into the basics and methods of nonlinear continuous optimisation (also called nonlinear programming).

Course description:
The course starts with some historical examples and an introduction into convex sets and convex functions. Then, optimality conditions in unconstrained and constrained optimization are discussed with emphasis on convex problems. Duality in convex optimization is the next topic followed by an introduction into the basic algorithms for unconstrained and constrained problems. Finally as a special topic, LP-, Lagrange- and semidefinite-relaxations of integer programs are studied.

Literature:
– Lecture notes "Nonlinear Optimization", by E. de Klerk, C. Roos, T. Terlaky;
– Algorithmic Principles of Mathematical Programming" by U. Faigle, W. Kern and G. Still.

Prerequisites:
Basic knowledge of linear algebra and multivariate analysis.

Examination:
Written examination.

Address of the lecturer:
Dr. J.C. Vera
Tilburg School of Economics and Management, Tilburg University
P.O. Box 90153, 5000 LE Tilburg
Phone: 013 – 4662478 E-mail: j.c.veralizcano@tilburguniversity.edu

Course DO: "Discrete Optimization"

Time : Monday 13.15 – 15.00 (September 23 – December 9).
Location: Utrecht (Uithof).
Lecturer: Prof.dr. G. Schäfer (VU University Amsterdam/CWI).

Aim:
To provide a solid foundation in Discrete Optimization, with an eye on algorithm design and algorithm analysis, including the basics of computational complexity.

Course description:
The aim of the course is to provide a solid foundation in Discrete Optimization. A particular focus will be given to the design and analysis of algorithms and to computational complexity. Discrete Optimization is about the problem of finding a best solution among a set of feasible solutions. The set of feasible solutions might be astronomically large but is assumed to be discrete (finite or countably infinite), which also constitutes the major difference to Continuous Optimization. A notorious example is the traveling salesman problem, where we are asked to find a shortest tour among all tours that visit every node of a given graph exactly once. Yet another example is linear programming, which can be interpreted as the problem of finding a best among a finite number of vertices of a polyhedron. The course introduces some of the most relevant problems from the area, as well as algorithms to solve them.

The following topics will (most probably) be treated:
− introduction to algorithms & analysis;
− shortest path algorithms;
− minimum spanning trees & matroids;
− maximum flows & minimum cuts;
− minimum cost flows;
− P, NP, coNP, NP-completeness;
− integer linear programming & total unimodularity;
− approximation algorithms;
− primal-dual algorithms;
− inapproximability & approximation schemes.

Literature:
We use a reader with selected chapters from several books listed below. The reader can be purchased in the first lecture. Occasionally additional copies will be distributed (if necessary).
− W.J. Cook, W.H. Cunningham, W.R. Pulleyblank and A. Schrijver, Combinatorial Optimization, Wiley, 1998. ISBN 0-471-55894-X;
− C.H. Papadimitriou and K. Steiglitz, Combinatorial Optimization; Algorithms and Complexity, Prentice-Hall, 1982. ISBN 0-13-152462-3;
− Ahuja, R.K., T.L. Magnanti, and J.B. Orlin, Network Flows, Prentice Hall, 1993. ISBN 0-13-617-549;
− T. Cormen, C. Leiserson, R. Rivest and C. Stein, Introduction to Algorithms, 2nd ed., MIT Press, 2001. ISBN10 0262531968;
− B. Korte and J. Vygen, Combinatorial Optimization - Theory and Algorithms, 4th ed., Springer, 2008. ISBN10 3-540-25684-9.

Prerequisites:
Knowledge of linear algebra and graph theory is advantageous.

Examination:
Take home problems (40%) and a written exam (60%).

Address of the lecturer:
Prof.dr. G. Schäfer
CWI, P.O. Box 94079, 1090 GB Amsterdam
Phone: 013 – 4662122 E-mail: g.schaefer@cwi.nl

Course HEU "Heuristic Methods in Operations Research"

Time : Monday 15.15 – 17.00 (September 23 – December 9).
Location: Utrecht (De Uithof).
Lecturers: Prof.dr. J.L. Hurink (University of Twente) and Dr. J.M.J. Schutten (University of Twente).

Aim:
This course gives an overview of heuristic solution methods in combinatorial optimization.

Description:
Due to the computational complexity of most of the practical relevant optimization problems, heuristic methods form an important class of solution methods for such problems. In this course we give an overview of different classes of heuristic solution approaches and present examples of their application.

In detail, the following issues are treated:
– Sampling based heuristics;
– Restricted dynamic programming;
– Truncated branch and bound/beam search;

– Relaxations/lower bounds;
– Evaluation techniques;
– Local Search;
– Evolutionary methods;
– Hierarchical and decentralized approaches.

Literature:
Handouts.

Examination:
Oral examination and take home problems.

Prerequisities:
Basic knowledge (bachelor level) of analysis, linear algebra and linear programming.

Addresses of the lecturers:
Prof.dr. J.L. Hurink
Department of Applied Mathematics, University of Twente
P.O. Box 217, 7500 AE Enschede
Phone: 053 – 4893447 E-mail: j.l.hurink@utwente.nl URL: www.math.utwente.nl/~hurinkjl

Dr.ir. J.M.J. Schutten
Department OMPL, University of Twente
P.O. Box 217, 7500 AE Enschede
Phone: 053 – 4894676 E-mail:j.m.j.schutten@utwente.nl URL: www.mb.utwente.nl/ompl/staff/Schutten/

Course ALP: "Advanced Linear Programming"

Time : Monday 11.00 – 12.45 (Febuary 3 – April 14, April 28).
Location: Utrecht (De Uithof).
Lecturers: Prof.dr. L. Stougie (VU University Amsterdam) and Dr.ir. J.M. van den Akker (Utrecht University).

Aim:
To provide insight in theory and development of practical methods for basic and advanced linear programming.

Course description:
Part 1: Basic theory and algorithms of linear optimization:
Linear optimization; polyhedra and polytopes; the simplex algorithm; duality; linear inequalities and Farkas' lemma; sensivity analysis.
Part 2: Advanced linear optimization methods:
The revised simplex method and column generation; Dantzig-Wolfe- and Benders' decomposition; network flow problems; the ellipsoid method; an interior point method; integer programming formulations and solution methods.

Literature:
D. Bertsimas and J.N. Tsitsiklis: Introduction to linear optimisation, Athena Scientific, 1997.

Prerequisites:
Basic knowledge (bachelor level) of linear algebra and graph theory.

Examination:
Written examination.

Addresses of the lecturers:
Prof.dr. L. Stougie
Department of Econometrics and Operations Research, VU University Amsterdam
De Boelelaan 1105, 1081 HV Amsterdam
Phone: 020 – 5989391 E-mail: l.stougie@vu.nl

Dr.ir. J.M. van den Akker
Department Informatica, Utrecht University
P.O. Box 80089, 3508 TB Utrecht
Phone: 030 – 2533989 E-mail: marjan@cs.uu.nl URL: http://people.cs.uu.nl/marjan/

Course SCH: "Scheduling"

Time : Monday 13.15 – 15.00 (Febuary 3 – April 14, April 28).
Location: Utrecht (De Uithof).
Lecturer: Dr. T. Vredeveld (Maastricht University).

Aim:
This course gives an introduction into scheduling theory and its applications.

Course description:
The term scheduling represents the assignment of resources over time to perform tasks, jobs or activities. Feasible schedules are compared with respect to a given optimality criterion. Mostly, the optimization problem is combinatorial and very complex. From a computational point of view many of these problems are hard (NP-hard). In this course an overview on the most classical scheduling models is given and exact as well as some optimal and some heuristic solution methods are discussed for these models.

In detail, the following issues are treated:
− classification of scheduling models;
− single-machine models;
− parallel-machines models;
− open shop, flow shop and job shop models;
− timetabling;
− transportation;
− on-line models.

Literature:
– Handout for special subjects.

The following books can be used as background and further information, but do not have to be bought:
– Brucker, Peter: Scheduling Algorithms 4th ed., 2004, Springer Verlag Berlin, Hardcover, ISBN: 3-540-20524-1;
– Pinedo, Michael L: Scheduling: Theory, Algorithms, and Systems, 2nd ed., 2002, Prentice Hall, ISBN: 0-13-028138-7.

Prerequisites:
Basic knowledge (bachelor level) of analysis and linear algebra.

Examination:
Take home problems and an examination (oral or written).

Address of the lecturer:
Dr. T. Vredeveld
School of Business and Economics, Department of Quantitative Economics, Maastricht University
P.O. Box 616, 6200 MD Maastricht
Phone: 043 – 3883911 E-mail: t.vredeveld@maastrichtuniversity.nl
URL: http://www.personeel.unimaas.nl/t.vredeveld

Course QT: "Queueing Theory"

Time : Monday 15.15 – 17.00 (Febuary 3 – April 14, April 28).
Location: Utrecht (De Uithof).
Lecturers: Prof.dr.ir. I.J.B.F. Adan (TU/e) and Dr. J.A.C. Resing (TU/e).

Aim:
To provide insight in the theory of queueing models.

Course description:
The following subjects will be treated:
– fundamental queueing relations (Little's law, PASTA property);
– Markovian queues (M/M/1 queue, M/M/c queue, M/E_r/1 queue) ;
– M/G/1 queue and G/M/1o queue;
– mean value technique;
– priority queues;
– variations of the M/G/1 queue;
– insensitive queues (M/G/c/c queue and M/G/infinity queue).

Literature:
Lecture notes of the course "Queueing Theory" (free available: http://www.win.tue.nl/~iadan/queueing.pdf).

Prerequisites:
Basic knowledge of probability at the level: S.M. Ross, Introduction to probability models, 9th edition, Academic Press, 2007 (chapters 1-3).

Examination:
Written examination.

Addresses of the lecturers:
Prof.dr.ir. I.J.B.F. Adan
Department of Mathematics and Computer Science, Eindhoven University of Technology
P.O. Box 513, 5600 MB Eindhoven
Phone: 040 – 2472932 E-mail: i.j.b.f.adan@tue.nl

Dr. J.A.C. Resing
Department of Mathematics and Computer Science, Eindhoven University of Technology
P.O. Box 513, 5600 MB Eindhoven
Phone: 040 – 2472984 E-mail: j.a.c.resing@tue.nl

6. LNMB certificated persons (245)

J.J. Aarts
M.E. Angün
E.M. Bázsa
J.J.P.H. Bierbooms
J.M. Bloemhof – Ruwaard
N.K. Boots
Y. Boulaksil
A. Braaksma
M. van Brink
J. Bruin
N.C. Büyükkaramikli
D. Chaerani
M.B. Combé
F.C.A.M. Cruijssen
Q. Deng
A.M. Dobber
T. Dollevoet
R. Egorova
M. Elghami
J.T. van Essen
Y. Feng
J. van der Gaast
J.R.G. van Gellekom
B. Gorissen
A. Grigoriev
R. de Haan
C.J.H. Hendriksen
B. Heydenreich
K.M.R. Hoen
D. Huisman
B.G.M. Husslage
I.D. Ivanov
J.B. Jansen
F.B.S.L.P. Janssen
F.J.P. Karsten
O.A. Kilic
J. Kleppe
A.L. Kok
N. Kortbeek
M. Koster
M.G.C. van Krieken
C.M.H. Kuijpers
T. Le Duc
P. Lieshout
E.R.M.A. Lohmann
F.J.W. Lutgens

F. Ahmed
A. Asadi
R. Bekker
M. Bijvank
C.A. Boer
S.C. Borst
H.W. Bouma
G.M. te Brake
M.P. de Brito Peirera Maduro
G. Budai
M. Calinescu
S.K. Cheung
U. Corbacioglu
G. Csapó
A.B. Dieker
C. Dobre
J.P. Dorsman
C.A. van Eijl
I. Endrayanto
A. Estevez Fernandez
M. Firat
O. Gabali
K. Glorie
F.N. Gouweleeuw
E.A. Grigorieva
A. Haesel
D. den Hertog
F.J. von Heymann
W.B. van den Hout
P.J.H. Hulshof
L.J.J. van Iersel
W. van Jaarsveld
M. Jansen
R.P. Kampstra
B. Kaynar
B.-E. Klaus
E. de Klerk
G.M. Koole
P. Korteweg
S. Kovaleva
D. Krushinsky
R. Langestraat
R.L.M.J. van Leensel
O. Listes
R.B. Lok
M. Mainegra Hing

J.M. van den Akker
N. Baër
S. Bhulai
H.M. le Blanc
K.M.J. de Bontridder
R.J. Boucherie
H.C.M. Bossers
R.C.M. Brekelmans
J.J.J. van de Broek
A. Bump
S. Caner
T.J.M. Coenen
M. Cremers
S. Dabia
E.B. Diks
M.K. Dogru
A.B. Dragut
E. Elabwabi
J. Ensinck
L. Evers
M. Frolkova
S.M. Geervliet
J.-W. Goossens
R.M.P. Goverde
G. Gu
R. Haijema
W. van den Heuvel
R.P. Hoeksma
G.J.J.A.N. van Houtum
E. van der Hurk
V.C. Ivanescu
B. Jansen
E. Janssen
A.G. Karaarslan
B. de Keijzer
M.J. Kleijn
F. Klijn
J. de Kort
A.M.C.A. Koster
A.F. van der Kraaij
B.H.M. Kuijpers
T. Le Anh
H.L. Liem
J.A. Loeve
J.M.W. van Loon
M.R.H. Mandjes

H. Mansouri
N.A.A. Marquinie
F.J.C. van Megen
G. Mincsovics
M. Mnich
R. Núñez Queija
D. van Ooteghem
P. Ouwehand
K. Pak
L.W.P. Peeters
E. Porras Musalem
M. Pourakbar
A.J. Quist
G. Rennen
J.M.M. van Rooij
J. Rutten
D. Sever
A. Sleptchenko
J. Smeltink
M. Sol
F.C.R. Spieksma
M.H. Streutker
D. Tas
M. Udenio
N. Usotskaya
S.G. Vanneste
H.J.J. Verheijen
A.J. Vermeulen
M. Vieira
M.H. van der Vlerk
J.P.A. van Vliet
M.J.C.M. Vromans
M. Wennink
R. Wildeman
Z. Yang
C.M. Zwaneveld

S. Marban
P.J.M. Meersmans
R.D. van der Mei
D.I. Miretskiy
R. Nicolai
N.J. Olieman
G.J.M. Otten
Ö. Özdemir
O. Passchier
N. Piersma
S.A. Pot
X. Qiu
G. Regts
M. Retel Helrich
A. Roubos
J.H.G.C. Rutten
A.Y.D. Siem
M. Slikker
M.A.J. Smith
M.J. Soomer
R. Spliet
S. van der Ster
M. Tennekes
M.J.G. van Uitert
R.J.M. Vaessens
E. Vatamidou
C. Verhoef
A.M. Verweij
I.F.A. Vis
I. Vliegen
Y. Volkovich
M. van Vuuren
W. van der Weij
E.M.M. Winands
T. Yuan
A.P. Zwart

B. Marchal
M.A. Meertens
W.J.M. Meuffels
M. Mitici
L. van Norden
M. Oosten
P. Out
U. Özen
J.J. Paulus
P.C. Pop
D. Potthoff
M. Quant
J.H. Reijnierse
D. Romero Morales
D. Roubos
B. Selçuk
B.P. Silalabi
E. Smeitink
S.R. Smits
P.F. Spaans
J.M. Spitter
J.F. Sturm †
R.H. Teunter
A. Ule
P.T. Vanberkel
E.J.M. van der Veen
M. Verloop
A.P.A. Vestjens
M. Vlasiou
A. van Vliet
T. Vredeveld
X. Wang
A.C.C. van Wijk
R. Yang
M.E. Zonderland

7. Structuurschets interne organisatie LNMB (in Dutch)

Vastgesteld in de algemene ledenvergadering van 16 januari 1991, aangepast in de algemene ledenvergaderingen van 16 januari 2007, 18 januari 2011 en 17 januari 2012

0. Preambule
De juridische structuur van het LNMB is nog niet vastgelegd, en dat gebeurt ook niet door onderstaande structuurschets. Op dit moment is het niet opportuun om de juridische aspecten volledig uit te werken, dat zal te zijner tijd gebeuren in samenhang met de uitwerking van de structurele financiering. Bovendien is het wenselijk om te wachten tot de discussie over "onderzoekscholen" verder gevorderd is. Wel is het op dit moment noodzakelijk om interne gedragsregels af te spreken, onder meer omdat de hoogleraar-directeur is aangesteld.

1. Het Landelijk Netwerk Mathematische Besliskunde
Het LNMB is een organisatie die een landelijke tweedefase-onderzoekersopleiding in de mathematische besliskunde verzorgt. Door landelijke bundeling van internationaal erkende expertise en door inzet van vooraanstaande onderzoekers uit het buitenland wordt gestreefd naar een opleiding van hoge kwaliteit. Het LNMB streeft naar een goede afstemming van activiteiten met de universitaire instellingen en met andere tweedefaseopleidingen.

2. Leden
Lid van het LNMB kunnen zijn hoogleraren, UHD's en UD's (inclusief emeriti) van de Nederlandse universiteiten of medewerkers van het CWI die actief onderzoeker zijn op een van de deelgebieden van de mathematische besliskunde en betrokken zijn bij de begeleiding van promovendi. Over toelating van nieuwe leden beslist het Algemeen Bestuur.

3. Algemeen Bestuur
Het Algemeen Bestuur bestaat uit ten minste n en ten hoogste $n+m$ leden van het LNMB, waar n = het aantal instellingen waar leden werkzaam zijn en m = het aantal leden van het Dagelijks Bestuur. Het Algemeen Bestuur wordt gekozen door de Ledenvergadering zodanig dat van elk van de n instellingen ten minste één personeelslid lid van het Algemeen Bestuur is. Leden van het Dagelijks Bestuur zijn automatisch lid van het Algemeen Bestuur. De voorzitter wordt in functie gekozen. De Wetenschappelijk Directeur is secretaris. Het Algemeen Bestuur verdeelt onderling de overige functies. Leden van het Algemeen Bestuur die geen lid zijn van het Dagelijks Bestuur treden jaarlijks af, en zijn terstond herkiesbaar. Voor de overige leden van het Algemeen Bestuur geldt het rooster van bestuursmutaties van het Dagelijks Bestuur.
Het Algemeen Bestuur heeft tot taak:
a. het benoemen van nieuwe leden van het LNMB;
b. het benoemen van de Wetenschappelijk Directeur;
c. het toezien op de activiteiten van het Dagelijks Bestuur;
d. het jaarlijks vaststellen van het algemeen en financieel verslag, alsmede van de begroting voor het komende jaar;
e. alles te doen wat de doelstellingen van het LNMB kan bevorderen.

4. Dagelijks Bestuur
Het Dagelijks Bestuur bestaat uit 5 of 6 leden van het LNMB. Het Dagelijks Bestuur wordt gekozen door de Ledenvergadering. Voorzitter en secretaris van het Algemeen Bestuur zijn tevens voorzitter en secretaris van het Dagelijks Bestuur. De leden van het Dagelijks Bestuur, m.u.v. de directeur, hebben een zittingstermijn van 4 jaar. Aftredende leden zijn éénmaal herkiesbaar. De zittingstermijn van de secretaris komt overeen met diens aanstelling als Wetenschappelijk Directeur.
De voorzitter wordt in functie gekozen en heeft een zittingstermijn van 4 jaar als voorzitter.
Het Dagelijks Bestuur heeft tot taak:
a. het vaststellen van het onderwijsprogramma van het LNMB, in het bijzonder de aanwijzing van de docenten;
b. het vaststellen van regels voor de beoordeling van de deelnemende aio's/oio's door de docenten en het vaststellen van slaagregels;
c. het vaststellen van cursusgelden, contributies, vergoedingen etc.;
d. het vaststellen van regelingen voor diploma's, en het afgeven van diploma's aan deelnemers die geslaagd zijn;
e. het jaarlijks uitbrengen van een begroting, ten behoeve van het Algemeen Bestuur;
f. het zorgdragen voor de continuïteit van de activiteiten van het LNMB; inhaken op actuele ontwikkelingen, het veilig stellen van structurele financiering etc.;
g. het adviseren van de Wetenschappelijk Directeur bij diens taakuitoefening;
h. alles te doen wat de doelstellingen van het LNMB kan bevorderen.
Het Dagelijks Bestuur is verantwoording verschuldigd aan het Algemeen Bestuur en aan de Ledenvergadering.

5. Wetenschappelijk Directeur

Het LNMB heeft een Wetenschappelijk Directeur. De functie van Wetenschappelijk Directeur wordt op hoogleraarniveau vervuld. De Wetenschappelijk Directeur wordt benoemd door het Algemeen Bestuur, in samenwerking met de penvoerende instelling. De termijn van de aanstelling wordt eveneens in overleg met de penvoerende instelling vastgelegd.

De Wetenschappelijk Directeur heeft tot taak:

a. het voorbereiden en doen uitvoeren van het onderwijsprogramma;
b. het beslissen omtrent toelating van deelnemers aan het onderwijsprogramma op grond van door het Dagelijks Bestuur vastgestelde regels;
c. het bijhouden van een administratie van deelnemers aan het onderwijsprogramma, en de door hen behaalde resultaten;
d. het toezicht houden op het financieel beheer dat namens het LNMB wordt gevoerd;
e. het voorbereiden van de vergaderingen van het Dagelijks Bestuur, het Algemeen Bestuur en de Ledenvergadering;
f. het opstellen van voorlichtingsmateriaal voor aio's/oio's en andere belangstellenden;
g. het verzorgen van goede contacten met de penvoerende instelling, met deelnemende aio's/oio's en hun promotoren, met docenten, met instellingen die bij het LNMB zijn betrokken en met verwante netwerken.

De Wetenschappelijk Directeur is verantwoording verschuldigd aan het Dagelijks Bestuur.

6. Ledenvergadering

Ieder kalenderjaar, bij voorkeur tijdens de jaarlijkse Lunteren-conferentie, wordt een Ledenvergadering gehouden, waar onder meer aan de orde komen:

a. het algemeen verslag over het afgelopen kalenderjaar;
b. de plannen voor het komende kalenderjaar.

De Ledenvergadering heeft verder tot taak:

c. de benoeming van de leden van het Dagelijks Bestuur en van het Algemeen Bestuur;
d. het vaststellen van de gedragregels die binnen het LNMB worden gehanteerd.

7. Financiën

Voor de periode 1989 - 1993 heeft de Minister van Onderwijs en Wetenschappen het LNMB een startsubsidie toegekend. Daarna hebben de instellingen via een jaarlijkse bijdrage gezorgd voor het voortbestaan van het LNMB. De gelden wordt beheerd door de penvoerende instelling. Betalingen behoeven de goedkeuring van de Wetenschappelijk Directeur, die gehouden is aan regels die door het Dagelijks Bestuur zijn vastgelegd.

8. Slot

In alle gevallen waarin deze regels niet voorzien, beslist het Dagelijks Bestuur.

8. Operations Research Groups at Dutch Universities and CWI

Nr.	Institution	Research Theme	Projectleader(s)
1a.	CWI	Algorithms, Combinatorics and Optimization	Laurent
1b.	CWI	Probability and Stochastic Networks	Van der Mei
2.	EUR	Operations Research	Dekker
3.	WUR	Operations Research	Van der Vorst
4a.	UvT	Operations Research	Van Dam
4b.	UvT	Operations Research and game theory	Borm
5a.	UM	Combinatorial optimization	Van Hoesel
5b.	UM	Game theory and optimization	Thuijsman
6.	RUG	Operations Research	Van der Vlerk
7.	UL	Stochastic Operations Research	Kallenberg
8a.	TUD	Interior point methods	Roos
8b.	TUD	Optimization	Aardal
9.a	TU/e	Combinatorial optimization	Woeginger
9.b	TU/e	Stochastic Operations Research	Boxma
10.	UvA	Deterministic and Stochastic Operations Research	Van Dijk
11.	UT	Discrete Optimization and Stochastic OR	Boucherie/Uetz
12.	UU	Algorithms and Optimization	van den Akker/Bodlaender
13a.	VU	Combinatorial Optimization and Stochastic OR	Stougie/Tijms
13b.	VU	Optimization of business processes	Koole

Project 1a. Centre for Mathematics and Computer Science (CWI)
Algorithms, Combinatorics and Optimization

Leader : Prof.dr. M. Laurent.
Address : Centre for Mathematics and Computer Science, Science Park 123, 1098 XG Amsterdam.
Phone : 020 – 5924105 / 020 – 5924189 (secretary).
Research staff : Prof.dr.ir. K.I. Aardal, Prof.dr. K. Apt, Dr. N. Bansal, Dr. J. Draisma, Prof.dr.ir. A.M.H. Gerards, Dr. D.C. Gijswijt, G. van den Hove, Dr. A. Katsampekis, B. de Keijzer, Prof.dr. M. Laurent, Prof.dr. J.K. Lenstra, Dr. T. Mueller, T. Piovesan, M. Rahn, G. Regts, Prof.dr. G. Schaefer, Prof.dr. A. Schrijver, Dr. S.E. Simon, Dr. R. Sitters and A. Varvitsiotis.

Research themes:
1. combinatorics and optimization;
2. algorithmic game theory.

Project 1b. Centre for Mathematics and Computer Science (CWI)
Probability and Stochastic Networks

Leader : Prof.dr. R.D. van der Mei and Prof.dr. A.P. Zwart.
Address : Centre for Mathematics and Computer Science (CWI)
Science Park 123, 1098 XG Amsterdam.
Phone : 020 – 5924129 / 020 – 5924199 (secretary).
Research staff : Drs. T. Van Barnevelt, Prof.dr. J. van den Berg, Drs. A.V. den Boer, Drs. J.W. Bosman, Drs.ir. M. van Buuren, Drs. S. Ding, Drs. J.P. Dorsman, Drs. L Duijvesteijn, Dr. K. Dzhaparidze, Drs. M. Frolkova, Dr. M. Heydenreich, Dr.ir. G.J. Hoekstra, Drs. C. Jagtenberg, Drs. R. Jonker, Drs. D. Kiss, Dr. M.N.M. van Lieshout, Prof.dr. R.D. van der Mei, Prof.dr. R. Nunez-Queija, Drs. M. Onderwater, Drs. F. Wetzels and Prof.dr. A.P. Zwart.

Research themes:
1. performance analysis of communication systems;
2. spatial stochastics and stochastic processes;
3. stochastic geometry.

Project 2. Erasmus University Rotterdam
Operations Research

Leader : Prof.dr.ir. R. Dekker.
Address : Econometric Institute, H11-33, Erasmus University Rotterdam
Postbus 1738, 3000 DR Rotterdam.
Phone : 010 – 4081274 / 010 – 4081264 (secretary).

Research staff : Dr. J. Brinkhuis, Prof.dr.ir. R. Dekker, Z.M. Dehkordi MSc, T. Dollevoet MSc, M. Hekimoglu MSc, Dr. W. van der Heuvel, Dr. D. Huisman, Dr. A. Gabor, K. Glorie MSc, Dr. T. Farenhorst-Yuan, Dr. D.K. Leegwater, I. Louwerse MSc, Dr. M. Mulder, J. Mulder MSc, M. Retel Helmrich MSc, R. Spliet MSc, Dr. T. Tervonen, W. van Jaarsveld MSc, Prof.dr. A.P.M. Wagelmans and G. Yang MSc.

Research themes:

Transportation:

1. railway operations optimization (Dekker, Dollevoet, Huisman, Louwerse, Wagelmans);
2. container and intermodal logistics (Dekker);
3. robust distribution networks (Dekker, Gabor, Mulder, Spliet);
4. design of liner shipping networks (Dekker, Mulder);

Supply chains:

5. production planning and inventory control (Dekker, van de Heuvel, Retel-Helmrich, Wagelmans);
6. service Logistics (Dekker, Gabor, Farenhorst-Yuan, Hekimoglu, van Jaarsveld, Yang);
7. coordination in supply chains (Dehkordi, van de Heuvel, Wagelmans);
8. reverse logistics (Dekker, van de Heuvel);
9. location and network problems (Mulder);

Various methods and topics:

10. OR in medical decision making (Glorie);
11. multi-criteria decision making (Tervonen);
12. optimization (Brinkhuis);
13. maintenance and reliability analysis (Dekker, Farenhorst-Yuan).

Project 3. Wageningen University
Operations Research and Logistics Group

Leader : Prof.dr.ir. J.G.A.J. van der Vorst.

Address : Operations Research and Logistics Group, Wageningen University
Hollandseweg 1, 6706 KN Wageningen.

Phone : 0317 – 485645.

Research staff : A. Banaszewska MSc, X. Bing MSc, Dr. J.M. Bloemhof-Ruwaard, Ir. G.D.H. Claassen, Dr. F. Cruijssen, Dr. R. Haijema, Dr. E.M.T. Hendrix, Ir. J.C. van Lemmen-Gerdessen, Drs. M. de Keizer, Drs. K.G.J. Pauls-Worm, W. Rijpkema MSc, Dr. R. Rossi, M. Soysal MSc, J. Vlajic MSc and Prof.dr.ir. J.G.A.J. van der Vorst.

Research themes:

1. quality controlled logistics:
– using advanced product quality information in logistics decision making for improved customer service and less food spoilage;
2. sustainable logistics:
– socio-economic and environmental performance measures, trade-offs to improve overall sustainable performance in agrifood chains;
3. planning and inventory control:
– production and inventory models for perishable products;
– models and algorithms for valorisation and robust design.

Project 4a. Tilburg University
Operations Research

Leader : Prof.dr.ir. E.R. van Dam.

Address : Department of Econometrics and Operations Research, CentER for Economic Research, School of Economics and Management, Tilburg University
P.O. Box 90153, 5000 LE Tilburg.

Phone : 013 – 4662430.

Research staff : Prof.dr. H.A. Akkermans, Prof.dr.ir. J. Ashayeri, Dr. J.P.C.Blanc, Prof.dr. P.E.M. Borm, Dr. R.C.M. Brekelmans, Prof. dr.ir. E.R. van Dam, Prof.dr.ir. H. Daniels, Prof.dr. A.M.B. De Waegenaere, Prof.dr. F.A. van der Duyn Schouten, Dr. J.C. Engwerda, Prof.dr.ir. H.A. Fleuren, Dr.ing. W.J.H. van Groenendaal, Dr. Gul Gurkan, Prof.dr.ir. W.H. Haemers, Prof.dr. H.J.M. Hamers, Prof.dr.ir. D. den Hertog, Dr. K.J.M. Huisman, Prof.dr. G. Kant, Prof.dr. J.P.C. Kleijnen, Prof. dr. E. de Klerk, Prof.dr. P.M. Kort, Prof.dr. M. Laurent, Dr.ir. M.J.P. Peeters, Dr. M. Quant, Dr. J.H. Reijnierse, Prof.dr. J.M. Schumacher, Dr. R. Sotirov, Prof.dr. A.J.J. Talman and Dr. J. Vera.

Research themes:

1. stochastic operations research;
2. deterministic operations research;
3. simulation;

4. combinatorial mathematics;
5. cooperative game theory.

Project 4b. Tilburg University
Operations Research and Game theory

Leaders : Prof.dr. P.E.M. Borm.
Address : Department of Econometrics and Operations Research, CentER for Economic Research, Tilburg School of Economics and Management, Tilburg University
P.O. Box 90153, 5000 LE Tilburg.
Phone : 013 – 4663026 / 013 – 4662340 (secretary).
Research staff : Drs.T. Boonen, Prof. dr. P.E.M. Borm, Drs. M. Groote Schaarsberg, Drs. S. Grundel, Prof.dr. H.J.M. Hamers, Dr. R. Hendrickx, Dr. J. Kleppe, Dr. R. Lindelauf, Prof.dr. H.W. Norde, Dr. M. Quant, Dr. H. Reijnierse, Drs. O. Selcuk, Drs. T. Suzuki and Prof. dr. A.J.J. Talman.

Research themes:
1. cooperative game theory;
2. non-cooperative game theory;
3. mathematical economics;
4. skill in games;
5. overt and covert network analysis.

Project 5a. Maastricht University
Combinatorial optimization

Leader : Prof.dr.ir. C.P.M. van Hoesel.
Address : Department of Quantitative Economics, Faculty of Economics, Maastricht University
P.O. Box 616, 6200 MD Maastricht.
Phone : 043 – 3883727 / 043 – 3883835 (secretary).
Research staff : Dr. A. Berger, Dr. A. Grigoriev, Dr. T. Harks, Prof.dr.ir. S. van Hoesel, Prof.dr. R. Müller and Dr. T. Vredeveld.

Research themes:
1. mechanisme design, combinatorial auctions;
2. network optimization;
3. planning and scheduling;
4. approximation;
5. pricing, revenue management;
6. supply chain management.

Project 5b. Maastricht University
Game Theory and Optimization

Leader : Dr. F. Thuijsman.
Address : Department of Knowledge Engineering, Maastricht University
P.O. Box 616, 6200 MD Maastricht.
Phone : 043 – 3883489 / 043 – 3883496 (secretary).
Research staff : I. Arcaya MSc, Dr. P. Bonizzi, M. Clerx MSc, M. Cluitmans MSc, Dr. P.J. Collins, Dr. J.J.M. Derks, Dr. J.M.H. Karel, Dr. S.M. Kelk, Dr.ir. J.Kuipers, Dr.ir. E. de Lange, N. Lekić MSc, Prof.dr.ir. R.L.M. Peeters, Dr. G.M. Schoenmakers, Dr. K. Staňková, Dr. F. Thuijsman, P. Uyttendaele MSc and Dr. R.L. Westra.

Research themes:
1. strategic optimization in networks (network formation games, Markov games, gene networks, phylogenetic networks, evolutionary models);
2. systems biology (signal processing, data mining, pattern recognition, computability).

Project 6. University of Groningen
Operations Research

Leader : Prof.dr. R.H. Teunter.
Address : Faculty of Economics and Business, University of Groningen
P.O. Box 800, 9700 AV Groningen.
Phone : 050 – 3638617 / 050 – 3637491 (secretary).
Research staff : Dr T. Bodea, Drs. H. Bouma, Drs. Serra Caner, Dr. B. Goldengorin, Ddrs. B. de Jonge, Prof.dr. W.K. Klein Haneveld, Drs. G. van der Heijde, D. Krushinsky MSc, Prof.dr. K.J. Roodbergen, Prof. dr. G. Sierksma, Drs. M.H. Streutker, Drs. B.G. Talsma, Prof.dr. R.H. Teunter, Prof. dr. I. Vis, Prof.dr. M.H. van der Vlerk and Dr. X. Zhu.

Research themes:
1. decision making under uncertainty and stochastic programming (Klein Haneveld, Streutker, van der Vlerk);
2. combinatorial optimization and quantitative logistics (Bouma, Goldengorin, van der Heijde, Roodbergen, Schakel, Sierksma, Talsma, Teunter, Vis);
3. service logistics and maintenance, reverse logistics, inventory control, forecasting, pricing and revenue management (Bodea, Caner, de Jonge, Teunter, Zhu).

Project 7. University of Leiden
Stochastic Operations Research

Leader : Dr. F.M. Spieksma.
Address : Mathematical Institute, University of Leiden
P.O. Box 9512, 2300 RA Leiden.
Phone : 071 – 5277128.
Research staff : H. Blok MSc, Drs D. Ertiningsih, L.Smit MSc and Dr. F.M. Spieksma.
Research themes:
1. Markov decision chains with applications in queueing networks;
2. Markov games;
3. stability properties of parametrised collections of Markov processes;
4. inventory control.

Project 8a. Delft University of Technology
Interior point methods

Leader : Prof.dr.ir. C. Roos.
Address : Faculty of Electrical Engineering, Mathematics and Computer Science,
Delft University of Technology, Mekelweg 4, 2628 CD Delft.
Phone : 015 – 2782530 / 015 – 2787486 (secretary).
Research staff : Ir. H.N. Post and Prof.dr.ir. C. Roos.
Research themes:
1. interior point methods for linear and non-linear optimization;
2. randomized (approximation) algorithms;
3. robust optimization.

Project 8b. Delft University of Technology
Optimization

Leader : Prof.dr.ir. K.I. Aardal.
Address : Faculty of Electrical Engineering, Mathematics and Computer Science,
Delft University of Technology, Mekelweg 4, 2628 CD Delft.
Phone : 015 – 2785093 / 015 – 2784109 (secretary).
Research staff : Prof.dr. K.I. Aardal, Dr. F. Vallentin, Dr. D. Gijswijt, Prof.dr.ir. C. Roos,
P. van den Berg, E. DeCorte, F. von Heymann, D. de Laat, S. Li, and H. Post.
Research themes:
1. integer and combinatorial optimization;
2. semidefinite/convex optimization;
3. harmonic analysis applied to optimization, lattices and optimization.

Project 9a. Eindhoven University of Technology
Combinatorial optimization

Leaders : Prof.dr. G.J. Woeginger.
Address : Dept. of Mathematics and Computer Science, Eindhoven University of Technology
P.O. Box 513, 5600 MB Eindhoven.
Phone : 040 – 2472412 (Woeginger) / 040 –2473130 (secretary).
Research staff : Dr. N. Basal, Dr.ir. C.A.J. Hurkens, Dr. J.C.M. Keijsper, Prof.dr. J.K. Lenstra,
Dr. R.A. Pendavingh, and Prof.dr. G.J. Woeginger.
Research themes:
1. combinatorial optimization;
1.1. graph and matroid structure theory;
1.2. complexity and approximation;
1.3. enumerative optimization;
1.4. optimization under uncertainty.

Project 9b. Eindhoven University of Technology
Stochastic Operations Research

Leaders : Prof.dr.ir. O.J. Boxma.
Address : Dept. of Mathematics and Computer Science, Eindhoven University of Technology
P.O. Box 513, 5600 MB Eindhoven.
Phone : 040 – 2472858 (Boxma) / 040 – 2473130 (secretary).
Research staff : Prof.dr.ir. I.J.B.F. Adan, S. Badila, Dr.ir. M.A.A. Boon, Prof.dr.ir. S.C. Borst, Ir. N. Bouman, Prof.dr.ir. O.J. Boxma, Drs. J.L. Dorsman, Dr. S. Kapodistria, Dr. J.S.H. van Leeuwaarden, Dr. A. Marynych, Dr. J.A.C. Resing, Ir. J. Sanders, Dr. F. Simatos, E. Vatamidou, Dr. M. Vlasiou, and A. Zocca.

Research themes:
1. stochastic operations research;
1.1. random walks and queueing theory;
1.2. performance analysis of computer- and communication systems;
1.3. performance analysis in operations management and logistics;
2. the EURANDOM program on Queueing and Performance Analysis.

Project 10. University of Amsterdam
Deterministic and Stochastic Operations Research

Leader : Prof.dr. N.M. van Dijk.
Address : Dept. of Econometrics, Faculty of Economics and Econometrics, University of Amsterdam
Roetersstraat 11, 1018 WB Amsterdam.
Phone : 020 – 5254215 / 020 – 5254217 (secretary).
Research staff : Prof.dr. N.M. van Dijk, Dr. C.W. Duin and Dr. H.J.J. van der Sluis.
Research themes:
1. Markov decision theory (van Dijk);
2. performance analysis of service networks (van Dijk, van der Sluis);
3. exact and bounding results for queueing networks (van Dijk);
4. scheduling algorithms and complexity (Duin, van der Sluis);
5. graph theory problems (Duin, Volgenant);
6. inventory models (van der Sluis);
7. transportation (van Dijk);
8. daily life applications of stochastic models (van Dijk, van der Sluis);
9. healthcare (van Dijk);
10. OR and simulation (van Dijk, van der Sluis);
11. OR and simulation (van Dijk, van der Sluis).

Project 11. University of Twente
Discrete Optimization and Stochastic Operations Research

Leaders : Prof.dr. R.J. Boucherie and prof.dr. M. Uetz.
Address : Faculty of Electrical Engineering, Mathematics & Computer Science,
University of Twente, P.O. Box 217, 7500 AE Enschede.
Phone : 053- 4893433 (secretary M. Uetz) / 053- 4893434 (secretary R. Boucherie).
Research staf : F. Ahmed MSc, N. Baer MSc, Dr.ir. V. Bakker, H.C.M. Bossers MSc, Prof.dr. R.J. Boucherie, A. Braaksma MSc, Y. Chen MSc, Prof.dr. N.M. van Dijk, Dr.ir. T.S.H. Driessen, Ir. T. van Essen, Y. Feng MSc, Dr.ir. J. Goseling, Dr.ir. M. de Graaf, R. Hoeksma MSc, Prof.dr. J.L. Hurink, J. de Jong MSc, Dr. W. Kern, T. van der Klauw MSc, N. Kortbeek MSc, Dr. N. Litvak, Dr. B. Manthey, M.A. Mitici MSc, Dr.ir. A. Molderink, S. Nykamp MSc, A. Ohuzalike MSc, Dr. J.C.W. van Ommeren, Dr.ir. G. Post, X. Qiu MSc, D. Reijsbergen MSc, Dr.ir. W.R.W. Scheinhardt, Dr. G.J. Still, H.A. Toersche MSc, Prof.dr. M. Uetz, E. van der Veen MSc, Dr. J.B. Vink-Timmer, N.M. van de Vrugt MSc, M. Zonderland MSc and A. Zwartjes MSc.

Research themes:
1. discrete mathematics, mathematical programming and stochastic operations research:
– combinatorial optimization, approximation algorithms, online algorithms, continuous optimization, graph theory, scheduling, timetabling, routing, pricing;
2. game theory:
– cooperative game theory, noncooperative game theory, stochastic game theory, algorithmic game theory, mechanism design;
3. stochastic operations research:
– telecommunication systems, queuing network analysis, large deviations, fluid models, pricing, wireless networks, IP networks;

4. supply chain management:
– manufacturing, scheduling, logistics, inventory models, reliability, maintenance, spare parts planning and control;
5. health care logistics;
6. energy management.

Project 12. University of Utrecht
Algorithms and Optimization

Leaders : Dr.ir. J.M. van den Akker, Dr. H.L. Bodlaender.
Address : Department of Information and Computing Sciences, Utrecht University
Princetonplein 5, 3584 CC Utrecht.
Phone : 030 – 253 3989 / 030 – 253 4409.
Research staff : Dr.ir. J.M. van den Akker, Dr. H.L. Bodlaender, B.M.P. Jansen MSc, Dr. J.A. Hoogeveen, Dr. J. Nederlof and M.E. van Kooten Niekerk MSc.

Research themes:
1. graph and network algorithms;
2. LP-based optimization algorithms;
3. search algorithms;
4. optimization under uncertainty.

Project 13a. VU University Amsterdam
Combinatorial Optimization and Stochastic Operations Research

Leaders : Prof.dr. L. Stougie.
Address : Department of Econometrics and OR, VU University Amsterdam
De Boelelaan 1105, 1081 HV Amsterdam.
Phone : 020 – 5986013.
Research staff : Dr. G.J. Franx, Prof.dr. J. Gromicho, Dr. B. Heidergott, Dr. D.A. van der Laan, Dr. R.D. Nobel, Dr. A.A.N. Ridder, Prof.dr. G. Schaefer, Dr.ir. R.A. Sitters, S.L. van der Ster MSc, Prof.dr. L. Stougie, Prof.dr. G.T. Timmer and W. Wolk-Makarewicz MSc.

Research themes:
1. combinatorial optimisation;
1.1. algorithms: complexity and approximation;
1.2. algorithmic game theory;
1.3. on-line algorithms;
1.4. computational biology;
2. stochastic operations research;
2.1. Markov decision algorithms for controlled queuing systems;
2.2. analysis and simulation of probabilities for rare events;
2.3. perturbation analysis and simulation techniques;
2.4. numerical algorithms based on Taylor series expansion;
2.5. stochastic programming.

Project 13b. VU University Amsterdam
Optimization of Business Processes

Leader : Prof.dr. G.M. Koole.
Address : Department of Mathematics, VU University Amsterdam
De Boelelaan 1081a, 1081 HV Amsterdam.
Phone : 020 – 5987755.
Research staff : Dr. R. Bekker, Dr. S. Bhulai, M. Calinescu, Drs. G.J. Kommer, Prof.dr. R.D. van der Mei, Ir. R. Meijer, Drs. D. Moeke, Drs. A. Roubos and Prof.dr. A.P. Zwart.

Research themes:
1. performance modeling of communication systems;
2. theory and applications of controlled queueing systems.

9. PhD Students

1	Ahmed, Mr. Faizan	University of Twente
2	Alvarez, E.	University of Twente
3	Arts, Ir. J.J.	Einhoven University of Technology
4	Badila, Serban	Technical University Eindhoven
5	Baër, Niek	Universiteit Twente
6	Bagheri, Mrs Samaneh	TU/e
7	Balvert, BSc Marleen	Tilburg University
8	Banasik, MSc Aleksander	Wageningen University
9	Banaszewska, MSc. A.	Wageningen University
10	Beemsterboer, MSc Bart	University of Groningen
11	Behfard, Sina	University of Twente
12	Berkhout, Joost	Vrije Universiteit (ABRI Junior Research
13	Besinovic, Mr. Nikola	Delft University of Technology
14	Bing, Xiaoyun	Wageningen Univerisity
15	Bloem, MSc. J.W.H. van	University of Twente
16	Blok, M.Sc. Herman	Leiden University
17	Bodnar, Peter	Aarhus University
18	Borgman, Nardo	Universiteit Twente
19	Bornaee, Mr. Amirahmad	TUDelft
20	Bosman, Joost	CWI Amsterdam
21	Bossers, MSc. Harm	University of Twente
22	Bouma, MSc. Harmen	University of Groningen
23	Bouman, N.	CWI Amsterdam
24	Bouman, Paul	Erasmus University
25	Bouman, MSc Niek	Technische Universiteit Eindhoven
26	Braaksma, MSc Aleida	University of Twente
27	Büyükkaramikli, Cagdas	Eindhoven University of Technology
28	Calinescu, MSc. M.	VU University Amsterdam
29	Caner, Serra	University of Groningen
30	Cao, Qi	University Medical Center of Groningen
31	Cetinay, MSc Hande	Tue
32	Chen, MSc. Yanting	Univeristy of Twente
33	Coenen, Ir. Tom	University of Twente
34	Cornelissen, ir. Kamiel	Universiteit Twente
35	Csapó, Gergely	Maastricht University School of Business and
36	Dabia, Ir. S.	Eindhoven University of Technology
37	de Groot, Msc Cindy	ORTEC B.V.
38	de Jong, MSc Jasper	University of Twente
39	De Vries, MSc Harwin	Erasmus University Rotterdam
40	DeCorte, Mr. Evan	TU Delft
41	Dickinson, MSc. P.J.C.	University of Groningen
42	Dijkstra, MSc Arjan	Rijksuniversiteit Groningen
43	Ding, Sihan	CWI
44	Diris, MSc. B.	University of Maastricht
45	Dorsman, Jan-Pieter	Eindhoven University of Technology
46	El-Kebir, drs. ir. Mohammed	CWI
47	Ensinck, Hans Ir.	Maastricht University
48	Ertiningsih, M.Si. Dwi	Universiteit Leiden
49	Essen, Ir. Theresia van	University of Twente

50	Evers, L. MSc.	Erasmus Universiteit
51	Fazi, M.A. Stefano	Technische Universiteit Eindhoven
52	Feng, Yuan	Universiteit Twente
53	Filatova, MSc. T.	University of Twente
54	Fleuren, Stijn	Eindhoven
55	Franceschetti, MSc Anna	Technische Universiteit Eindhoven
56	Frolkova, M.	CWI
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