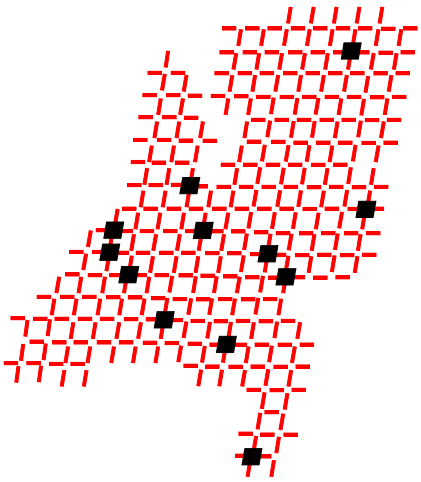

DUTCH NETWORK ON THE MATHEMATICS OF OPERATIONS RESEARCH (LNMB)

MASTER AND PhD PROGRAMME IN OPERATIONS RESEARCH

Information Guide 2017/2018

June 2017

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… and all members of the Executive board

Website: www.lnmb.nl

CONTENTS

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 24 courses for Master and PhD students. This year six 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 2017/2018 consists of the following courses.

Master courses:
Fall 2017:
– Continuous Optimization;
– Discrete Optimization;
– Heuristic Methods in Operations Research.
Spring 2018:
– 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;
− Advanced Topics in Stochastic Operations Research.
Trimester 3:
− Robust Optimization;
− Algorithmic Game Theory;
− Stochastic Programming.

Besides information about the LNMB courses, this guide contains:
− organisational 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 43th Lunteren Conference on the Mathematics of Operations Research. This conference will be held 16 – 18th January 2018.

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

Johann Hurink,
Director LNMB
June, 2017

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 120 members and 254 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 18 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 receive a diploma. Here, ‘sufficiently’ means that they have passed at least 6 LNMB PhD courses with success, whereby one of the courses may be replaced by a course of the graduate program GP-OML and whereby in consultation with the supervisor one course may be replaced by a Master course. If PhD courses have already been taken during the Master program, these courses are also taken into consideration for the LNMB diplom and it is mentioned on the diploma that the courses are part of a Master program. 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.

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 at that time, a national concentration led to an increase in efficiency. This was intitially the main purpose of the LNMB Master courses. Additional advantages were and are that this setup can help to guarantee a qualitatively high education and that the students get in 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 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 (https://elo.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 2017/2018

During the academic year 2016/2017 nine courses will be taught in three trimesters; each trimester has a duration of ten weeks. Within the first nine weeks of a trimetser one lecture for each course is given; the last week can be used if a lecture has to be cancelled in the first nine weeks.

Trimester 1: (September 11 – November 13)

- Markov Decision Processes (MDP) — Bhulai/Spieksma
- Algorithms and Complexity (AC) — Nederlof
- Interior Point Methods (IPM) — de Klerk

Trimester 2: (November 20 – December 18 and January 22 – February 19)

- Integer Programming Methods (IntPM) — Gijswijt
- Noncooperative Games (NCG) — Thuijsman
- Advanced Topics in Stochastic Operations Research (ATS) — van de Ven/den Boer

Trimester 3: (February 26 – March 26 and April 9 – May 7)

- Algorithmic Game Theory (AGT) — Schäfer
- Robust Optimization (RO) — den Hertog
- Stochastic Programming (SP) — Romeijnders

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

	Trimester 1	*Trimester 2*	*Trimester 3*
11.00 – 11.45	Course MDP	Course IntPM*	Course AGT
12.00 – 12.45	Course MDP	Course IntPM*	Course AGT
12.45 – 13.15	Lunch break	Lunch break	Lunch break
13.15 – 14.00	Course AC*	Course NCG	Course RO
14.15 – 15.00	Course AC*	Course NCG	Course RO
15.15 – 16.00	Course IPM	Course ATS	Course SP
16.15 – 17.00	Course IPM	Course ATS	Course SP

* = in cooperation with DIAMANT

Location:
The courses are given in the Uithof (buildings of the Utrecht University), in the Hans Freudenthalbuilding, Room 611AB, Budapestlaan, Utrecht.

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 11.00 – 12.45 (September 11 – November 13).
Location: Hans Freudenthalgebouw, Room 611AB, Budapestlaan, Utrecht
Lecturers: Prof.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:
Prof.dr. S. Bhulai
Department of Mathematics, VU University Amsterdam
De Boelelaan 1081a, 1081 HV Amsterdam
Phone: 020 – 5987679 E-mail: sbhulai@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 13.15 – 15.00 (September 11 – November 13).
Location: Hans Freudenthalgebouw, Room 611AB, Budapestlaan, Utrecht.
Lecturer: Dr. J. Nederlof (Eindhoven University of Technology).

Course description:
Principles for construction of algorithms: Decomposition, greedy algorithms, dynamic programming. Algorithm analysis. Probabilistic algorithms. Approximation. Selected applications to sets, graphs, and geometry. Exponential time algorithms and Fixed Parameter Tractability.
Complexity Theory: Reductions. Complexity classes P (polynomial time), NP (non-deterministic polynomial time). NP-complete problems.

Literature:
Most material will be provided on the website. Additionally, for parts of the course it may be useful to buy the book `Introduction to Algorithms', by Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein.

Prerequisites:
Knowledge of basic mathematics (set and logic notation, linear algebra, proof by induction, probability theory, big-O notation).

Examination:
Homework.

Address of the lecturer:
Dr. J. Nederlof
Dept. of Mathematics & Computer Science
Eindhoven University of Technology, P.O. Box 513, 5600 MB Eindhoven
Phone: 040 - 2478940 E-mail: j.nederlof@tue.nl URL: http://www.win.tue.nl/~jnederlo/

Course IPM: "Interior Point Methods"

Time: Monday 15.15 – 17.00 (September 11 – November 13).
Location: Hans Freudenthalgebouw,, Room 611AB, Budapestlaan, Utrecht.
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 11.00 – 12.45 (November 20 – December 18 and January 22 – February 19).
Location: Hans Freudenthalgebouw, Room 611AB, Leuvenlaan, Utrecht.
Lecturer: Dr. D.C. Gijswijt (Delft University of Technology).

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:
Conforti, Cornuéjols, and Zambelli, Integer programming, Springer 2014 (available online via springerlink).

Prerequisites:
Knowledge of linear algebra and linear programming.

Examination:
Take home problems.

Address of the lecturer:
Dr. Dion Gijswijt
Delft University of Technology, Delft Institute of Applied Mathematics
P.O. Box 5031, 2600 GA Delft
Phone: 015 2787292 E-mail: dion[dot]gijswijt[at]gmail[dot]com

Course NCG: "Noncooperative Games"

Time: Monday 13.15 – 15.00 (November 20 – December 18 and January 22 – February 19).
Location: Hans Freudenthalgebouw, Room 611AB, Budapestlaan, Utrecht.
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:
Dr. F. Thuijsman
Department of Knowledge Engineering, Maastricht University
P.O. Box 616, 6200 MD Maastricht
Phone: 043 – 3883489 E-mail: f.thuijsman@maastrichtuniversity.nl
URL: http://dkemaastrichtuniversity.nl/f.thuijsman

Course ATS: "Advanced Topics in Stochastic Operations Research"

Time: Monday 15.15 – 17.00 (November 20 – December 18 and January 22 – February 19).
Location: Hans Freudenthalgebouw, Room 611AB, Budapestlaan, Utrecht.
Lecturer: Dr. A.V. den Boer (Universiteit van Amsterdam), Dr. P.M. van de Ven (CWI).
Course description:
The course topics are control of complex stochastic networks and multi-armed bandits.
This course consists of two parts. In the first part we consider the control of 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.
The second part of this course provides an introduction to the theory of Multi-armed bandits. This is the current paradigm for studying decision-problems under uncertainty, where the optimal decisions in some optimization problem have to be learned in an online fashion.

Keywords: workload models, learning, pricing, distributed control, stabilizing stochastic systems. Applications to manufacturing, energy, wireless and road traffic networks.

Literature:
Frank Kelly and Elena Yudovina - Stochastic 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 lecturers:
Dr. A.V. den Boer
Faculteit der Natuurwetenschappen, Wiskunde en Informatica
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Postbus 94248, 1090 GE Amsterdam
Phone: 020-5252497 E-mail: A.V.denBoer@uva.nl

Dr. P.M. van de Ven
Stochastics, CWI
P.O. Box 94079, 1090 GB Amsterdam
Phone: 020-5924135 E-mail: ven@cwi.nl

Course AGT: "Algorithmic Game Theory"

Time: Monday 11.00 – 12.45 (February 26 – March 26 and April 9 – May 7).
Location: Hans Freudenthalgebouw, Room 611AB, Budapestlaan, Utrecht.
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 RO: "Robust Optimization"

Time: Monday 13.15 – 15.00 (February 26 – March 26 and April 9 – May 7).
Location: Hans Freudenthalgebouw, Room 611AB, Budapestlaan, Utrecht.
Lecturer: Prof.dr.ir. D. den Hertog (Tilburg University).

Course description:
Optimization problems often contain parameters that are uncertain. The recent methods developed in Robust Optimization try to find solutions that are robust against these uncertainties. The idea is to define a so-called uncertainty region for the uncertain parameters, and then require that the constraints should hold for all parameter values in this uncertainty region. For several optimization problems, and for several choices of the uncertainty region, it has been shown that this so-called robust counterpart problem can be reformulated as tractable optimization problems.

The main topics treated are:
- Uncertain *lineair* optimization (LO) problems:
  - data uncertainty in LO;
  - tractability of robust counterparts;
  - non-affine perturbations;
  - applications in logistics, marketing, finance, engineering, … .
- Uncertain *nonlineair* optimization problems:
  - tractability of robust counterparts;
  - examples.
- Robust adjustable multistage optimization:
  - adjustable robust counterpart;
  - affine decision rules;
  - non-affine decision rules.
- Robust counterpart approximations of scalar chance constraints:
  - how to specify an uncertainty set?;
  - chance constraints;
  - safe tractable approximations.
- Globalized robust counterparts of uncertain problems:
  - motivation and definition of globalized robust counterpart;
  - computational tractability.

Literature:
– handouts;
– selected parts of: A. Ben-Tal, L. El-Ghaoui, A. Nemirovski, Robust Optimization, Princeton Series in Applied Mathematics , 2009.

Prerequisites:
– knowledge of basic linear algebra;
– knowledge of linear programming and duality;
– basic knowledge of convex analysis and non-linear optimization.

Examination:
Take home problems.

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Course SP: "Stochastic Programming"

Time: Monday 15.15 – 17.00 (February 26 – March 26 and April 9 – May 7).
Location: Hans Freudenthalgebouw, Room 611AB, Budapestlaan, Utrecht.
Lecturers: Dr. W. Romeijnders (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:
Dr. W. Romeijnders
Department of Operations, University of Groningen
P.O. Box 800, 9700 AV Groningen
Phone: 050 – 3638613 E-mail: w.romeijnders@rug.nl

5. Master courses 2017/2018

During the academic year 2017/2018 six 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 (https://elo.mastermath.nl/).

Fall 2017 (September 11 – November 27):
– CO (Continuous optimization);
– DO (Discrete optimization);
– HEU (Heuristic Methods in Operations Research).

Spring 2018 (February 5 – April 27, April 9 – May 7):
– SCH (Scheduling);
– ALP (Advanced linear programming);
– QT (Queueing theory).

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

	Fall 2015	*Spring 2016*
11.00 – 11.45	Course CO	Course SCH
12.00 – 12.45	Course CO	Course SCH
12.45 – 13.15	Lunch break	Lunch break
13.15 – 14.00	Course DO	Course ALP*
14.15 – 15.00	Course DO	Course ALP*
15.15 – 16.00	Course HEU	Course QT
16.15 – 17.00	Course HEU	Course QT

* 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): https://elo.mastermath.nl/.

Credits:
The credits for students who have passed the exercises successfully are 6 EC per course.

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 https://elo.mastermath.nl/ . On this website you can also find more information on the content of the courses, the location and any further relevant information.

Course CO: "Continuous Optimization"

Time : Monday 11.00 – 12.45 (September 11 – November 27)
Location: Utrecht (De Uithof)
Lecturer: Dr. P.J.C. Dickinson (University of Twente)

Address of the lecturer:
Dr. P.J.C. Dickinson
Dept. of Applied Mathematics, Faculty EEMCS, University of Twente
P.O. Box 217, 7500 AE Enschede
Phone: 053 – 4894264 E-mail: p.j.c.dickinson@utwente.nl

Course DO: "Discrete Optimization"

Time : Monday 13.15 – 15.00 (September 11 – November 27)
Location: Utrecht (Uithof)
Lecturer: Dr. A. Berger (Maastricht University), Prof.dr. M. Uetz (University of Twente)

Address of the lecturers:
Dr. A. Berger
School of Business and Economics, Department of Quantitative Economics, Maastricht University
P.O. Box 616, 6200 MD Maastricht
Phone: 043- 3884894 E-mail: a.berger@maastrichtuniversity.nl

Prof.dr. M. Uetz
Dept. of Applied Mathematics, Faculty EEMCS, University of Twente
P.O. Box 217, 7500 AE Enschede
Phone: 053 – 489 3402 E-mail: m.uetz@utwente.nl

Course HEU "Heuristic Methods in Operations Research"

Time : Monday 15.15 – 17.00 (September 11 – November 27)
Location: Utrecht (De Uithof)
Lecturers: Prof.dr. J.L. Hurink (University of Twente), Dr. J.M.J. Schutten (University of Twente)

Addresses of the lecturers:
Prof.dr. J.L. Hurink
Dept. of Applied Mathematics, Faculty EEMCS, 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
Dept. OMPL, University of Twente
P.O. Box 217, 7500 AE Enschede
Phone: 053 – 4894676 E-mail:j.m.j.schutten@utwente.nl
URL: https://www.utwente.nl/en/bms/iebis/staff/schutten/

Course ALP: "Advanced Linear Programming"

Time : Monday 11.00 – 12.45 (February 05 – March 26, April 9 – May 7)
Location: Utrecht (De Uithof)
Lecturers: Prof.dr. L. Stougie (VU University Amsterdam), Dr.ir. J.M. van den Akker (Utrecht University)

Addresses of the lecturers:
Prof.dr. L. Stougie
Dept. 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
Dept. 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 (February 05 – March 26, April 9 – May 7)
Location: Utrecht (De Uithof)
Lecturer: Dr. J.A. Hoogeveen (Utrecht University), Dr. T. Vredeveld (Maastricht University)

Addresses of the lecturers:
Dr. J.A. Hoogeveen
Dept. Informatica, Utrecht University
P.O. Box 80089, 3508 TB Utrecht
Phone: 030 – 2534089 E-mail: J.A.Hoogeveen@uu.nl URL: http://people.cs.uu.nl/slam/

Dr. T. Vredeveld
School of Business and Economics, Dept. 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 (February 05 – March 26, April 9 – May 7)
Location: Utrecht (De Uithof)
Lecturers: Dr. J.A.C. Resing (Eindhoven University of Technology)

Address of the lecturer:
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. 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, 17 januari 2012 en 13 januari 2015.

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 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 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 vijf of zes 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 vier jaar. Aftredende leden zijn éénmaal herkiesbaar. De zittingstermijn van de secretaris komt overeen met diens aanstelling als directeur.
De voorzitter wordt in functie gekozen en heeft een zittingstermijn van vier 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 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. Directeur

Het LNMB heeft een directeur. De functie van directeur wordt op hoogleraarniveau vervuld. De 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 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 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 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.

7. Operations Research Groups at Dutch Universities and CWI

Nr.	Institution	Research Theme	Projectleader(s)
1a.	CWI	Networks & Optimization	Schäfer
1b.	CWI	Stochastics	Zwart/Van der Mei
2.	EUR	Operations Research	Dekker
3.	WUR	Operations Research	Bloemhof-Ruwaard
4a.	UvT	Operations Research	Sotirov
4b.	UvT	Game Theory	Borm
5a.	UM	Combinatorial optimization	Van Hoesel
5b.	UM	Game theory and optimization	Thuijsman
6.	RUG	Operations Research	Teunter
7.	UL	Stochastic Operations Research	Spieksma
8	TUD	Optimization	Aardal
9.a	TU/e	Combinatorial optimization	-
9.b	TU/e	Stochastic Operations Research	Boxma
10.	UvA	Applied probability and Discrete mathematics	Mandjes/Schrijver
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
13b.	VU	Optimization of business processes	Koole

Project 1a. Centre for Mathematics and Computer Science (CWI)
Networks & Optimization

Leader : Prof.dr. G. Schäfer
Address : Centre for Mathematics and Computer Science (CWI)
Science Park 123, 1098 XG Amsterdam
Phone : 020 – 5924105 / 020 – 5924189 (secretary)
Research staff : Prof.dr. Krzysztof Apt, Prof.dr. Nikhil Bansal, Dr. Daniel Dadush, Dario Frascaria, Prof.dr. Bert Gerards, Sander Gribling, Dr. Cristobal Guzman, Irving van Heuven, Sophie Huiberts, Dr. Bart de Keijzer, Pieter Kleer, Dr. David de Laat, Prof.dr. Monique Laurent, Dr. Neil Olver, Prof.dr. Lex Schrijver, Prof.dr. Guido Schäfer, Matteo Seminaroti and Dr. Rene Sitters.

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

Project 1b. Centre for Mathematics and Computer Science (CWI)
Stochastics

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 : Dr. J. Arts, Drs. T. Van Barneveld, Prof.dr. J. van den Berg, Prof.dr. J.L. van den Berg, V. van den Brekel, W. Boerrigter, Dr. J.W. Bosman, Drs.ir. M. van Buuren, Drs. E.J. Cahen, Dr. C.H. Rhee, Dr. E. Dugundji, Dr. K. Dzhaparidze, Drs. S. Gharanfari, Drs. I. van Heuven-Steareling, Drs. A. Hristov, Drs. C. Jagtenberg, Drs. B. Kamphorst, Drs. J. Klein, M. Kremer, Drs. G. Legemaate, Drs. D. van Leeuwen, Drs. M. Mahfoud, Dr. M.N.M. van Lieshout, Prof.dr. R.D. van der Mei, Dr. T. Mueller, Dr. T. Nesti, Prof.dr. R. Núñez-Queija, Dr. J. Salguero, Drs. D.D. Sierag, Drs. W. van der Sluis, Drs. D. Usanov, Dr. P.J. van der Ven, Drs. P. Vis, Drs. F. Wetzels, Dr. A. Zocca, Prof.dr. A.P. Zwart and Drs. B. Zweers.

Research themes:
1. applied probability;
2. spatial probability;
3. logistics;
4. communication networks;
5. energy systems.

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, Hekimoglu);
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, Wagelmans);
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. J.M. Bloemhof-Ruwaard
Address : Operations Research and Logistics Group, Wageningen University
Hollandseweg 1, 6706 KN Wageningen
Phone : 0317 – 485645
Research staff : Dr. R. Akkerman, A.G. Beames, I. Badraoui MSc, Dr. B. Behdani, Prof.dr. J.M. Bloemhof-Ruwaard, M. Buisman MSc, Ir. G.D.H. Claassen, Y. Fan MSc, Drs. J. Groot, Dr. X. Guo, Dr. R. Haijema, Dr. E.M.T. Hendrix, A. Ivancic MSc, J. Jonkman MSc, Dr. A. Kanellopoulos, Dr. D. Krushynskyi, Ir. J.C. van Lemmen-Gerdessen, L. Macheka MSc, W. Mu MSc, V. Nguyen MSc, Drs. K.G.J. Pauls-Worm, S. Rohmer MSc and H. Stellingwerf MSc.

Research themes:
1. sustainable supply chains;
2. quality and waste in food supply chains;
3. sustainable diets;
4. metropolitan logistics;
5. circular (biobased) economy and logistics.

Project 4a. Tilburg University
Operations Research

Leader : Prof.dr. R. Sotirov
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, Dr. J.P.C.Blanc, Dr. R.C.M. Brekelmans, Prof.dr.ir. E.R. van Dam, Prof.dr.ir. H. Daniels, Prof.dr. A.M.B. De Waegenaere, 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, Prof.dr. R. Sotirov, Prof.dr. A.J.J. Talman and Dr. J. Vera.

Research themes:
1. stochastic operations research and simulation;
2. deterministic operations research;
3. combinatorial mathematics;
4. game theory.

Project 4b. Tilburg University
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 : Prof. dr. P.E.M. Borm, B. Dietzenbacher (PhD-student), Prof. dr. H.J.M. Hamers, Dr. R.L.P. Hendrickx, Prof. dr. H. Norde, Dr. M. Quant, J. Schouten (PhD-student) 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. Abiad, Dr. A. Berger, Dr. A. Grigoriev, Prof.dr.ir. S. van Hoesel, Dr. M. Mnich, 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
Research staff : 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, Dr. R.L. Westra and L. You MSc.

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 – 3637020 (secretary)
Research staff : Drs. B. Beemsterboer, Drs. P. Buis, Drs. B. de Jonge, Dr. N. v. Foreest, Prof.dr. W.K. Klein Haneveld, Drs. G. van der Heijde, Dr. B. Jargalsaikhan, Drs. K. Karousis, Drs. M. Olde Keizer, Drs. D. Prak, Drs. W. Romeijnders, Prof.dr. K.-J. Roodbergen, Drs. A. Schrotenboer, Prof.dr. G. Sierksma, Prof.dr. R.H. Teunter, Drs. M. uit het Broek, Dr. J. Veldman, Prof.dr. I. Vis, Dr. E. Ursavas, Drs. M. Veenstra, Prof.dr. M.H. van der Vlerk and Dr. X. Zhu.

Research themes:
1. service logistics and Maintenance, Forecasting and Inventory control, Game theory (Beemsterboer, de Jonge, Foreest, Karousis, Olde Keizer, Prak, Teunter, Veldman, Zhu);
2. stochastic programming (Klein Haneveld, Romeijnders, van der Vlerk);
3. combinatorial optimization and Quantitative logistics (van der Heijde, Roodbergen, Sierksma);
4. maritime logistics (Buis, Jargalsaikhan, Schrotenboer, Uit het Broek, Ursavas, Veenstra, Vis).

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, Dr. J.L. Dorsman, L.Smit MSc and Dr. F.M. Spieksma.
Research themes:
1. Markov decision chains with applications in queueing networks;
2. stability properties of parametrised collections of Markov processes;
3. inventory control;
4. network robustness.

Project 8. 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, M. van Engelen, Dr. J.T. van Essen, Dr. D. Gijswijt, Dr. Leo van Iersel, R. Janssen, T. Janssen, M.E.L. Jones, Prof.dr. Etienne de Klerk, F. de Oliveira Filho, H, Post, Prof.dr.ir. C. Roos and Jos Weber.

Research themes:
1. integer and combinatorial optimization;
2. semidefinite/convex optimization;
3. harmonic analysis applied to optimization, lattices and optimization;
4. optimization in ambulance planning;
5. machine learning;
6. phylogenetic networks;
7. parametrized complexity.

Project 9a. Eindhoven University of Technology
Combinatorial optimization

Leaders : vacancy
Address : Dept. of Mathematics and Computer Science, Eindhoven University of Technology
P.O. Box 513, 5600 MB Eindhoven
Phone : 040 – 2473130 (secretary)
Research staff : Prof.dr. N. Basal, Dr.ir. C.A.J. Hurkens, Dr. J. Nederlof and Dr. R.A. Pendavingh.

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. S.C. Borst / Prof.dr.ir. O.J. Boxma / Prof.dr. J.S.H. van Leeuwaarden
Address : Dept. of Mathematics and Computer Science, Eindhoven University of Technology
P.O. Box 513, 5600 MB Eindhoven
Phone : 040 – 2475105 (Borst) / 040 – 2472858 (Boxma) / 040 – 2472813 (van Leeuwaarden)
040 – 2473130 (secretary)
Research staff : M.A. Abidini, A. Aveklouris, G. Bet, Dr.ir. M.A.A. Boon, Prof.dr.ir. S.C. Borst, Prof.dr.ir. O.J. Boxma, F. Cecchi, S. Dhara, Dr. S. Kapodistria, Prof.dr. J.S.H. van Leeuwaarden, M. Mayank, Ir. T.M.M. Meyfroyt, D. Mukherjee, Drs. B. Post, Dr. J.A.C. Resing, Ir. J. Selen, Drs. F. Sloothaak, Drs. C. Stegehuis, Dr. M. Vlasiou, and Prof.dr. A.P. Zwart (0.2 fte).

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
Applied probability and Discrete mathematics

Leader : Prof.dr. M.R.H. Mandjes, prof.dr. A. Schrijver
Address : Korteweg-de Vries Institute for Mathematics, University of Amsterdam, P.O. Box 94248, 1090 GE Amsterdam.
Phone : 020 – 525 (Mandjes); 020 – 525 5217 (secretary)
Research staff : A. Abhishek MSc, M. van Beek MSc, dr. A.V.den Boer, dr. C.J. Carstens, dr. J.L. Dorsman, S. Ghazanfari MSc, J.M.A. Heemskerk MSc, M.A. de Kemp MSc, D.T. Koops MSc, J. Kuhn MSc, B.M. Litjens MSc, prof.dr. M.R.H. Mandjes, prof.dr. R. Núñez Queija, dr. V.S. Patel, dr. G. Regts, B.L. Sevenster MSc, N.J. Starreveld MSc, prof.dr. A. Schrijver, dr. L. Vena Cros, dr.ir. E.M.M. Winands

Research themes:
1. Applied probability, queueing theory, stochastic networks, stochastic operations research
2. Discrete mathematics, combinatorial optimization, deterministic operations research, networks and graphs.

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 – 4893434 (secretary Boucherie) / 053 – 4893433 (secretary Uetz)
Research staf : X. Bai (PhD student), I.A. Bikker (PhD student), Prof.dr. R.J. Boucherie, N.J. Borgman (PhD student), J. Bos, (PhD student), S.P.J. van Brummelen (PhD student), A. Buijsrogge (PhD student), T.J.M. Coenen (PhD student), Dr. P.J.C. Dickinson, Prof.dr. N.M. van Dijk, Dr. M. Drees (PostDoc), Dr. ir. M. Gerards, G.J.H de Goeijen (PhD student), Dr.ir. J. Goseling, Dr.ir. M. de Graaf, M. Haji Ghasemi (PhD student), G. Hoogsteen (PhD student), B. Homan (PhD student), Prof.dr. J.L. Hurink, Dr. J. de Jong, Dr. W. Kern, Dr. T. van der Klauw (PostDoc), S. Klootwijk (PhD student), C. Laan (PhD student), G. Leeftink (PhD student), X. Li (PhD student), Prof.dr. M.N.M. van Lieshout, Dr. N. Litvak, Dr. B. Manthey, A. Oblakova (PhD student), Dr. J.C.W. van Ommeren, M. Otten (PhD student), Dr.ir. G.F. Post, D.F. Quintero Pulido (PhD student), V.M.J.J. Reijnders (PhD student), J.H.J. van Sambeeck (PhD student), Dr.ir. W.R.W. Scheinhardt, A.J. Schneider (PhD student), M. Schoot Uiterkamp (PhD student), B. Serbetci (PhD student), W. vd Sluis (PhD student), Dr. G.J. Still, P. Sun (PhD student), Dr. J.B. Timmer, Prof.dr. M. Uetz, B. Vieira (PhD student), Dr.ir. N.M. van de Vrugt and S. Wu (PhD student).

Research themes:
1. Discrete Mathematics & Mathematical Programming:
- continuous and combinatorial optimization, analysis of algorithms, approximation & online algorithms, graph theory, scheduling, operations research;
2. Stochastic Operations Research:
- telecommunication systems, queuing networks, large deviations, fluid models, pricing, wireless networks, IP networks, analysis of graphs and networks;
3. Game Theory:
- cooperative and Non-cooperative game theory, stochastic game theory, algorithmic game theory, mechanism design;
4. Operations Research:
- manufacturing, logistics, inventory models, reliability, maintenance, transportation, traffic models, supply chain management;
5. Health care logistics:
- strategic, tactical and operational decision making to improve healthcare systems;
6. Energy Systems:
- modelling, optimization, and control of smart energy grids and systems.

Project 12. University of Utrecht
Algorithms and Optimization

Leaders : Dr.ir. J.M. van den Akker and Prof.dr. H.L. Bodlaender
Address : Department of Information and Computing Sciences, Utrecht University
Princetonplein 5, 3584 CC Utrecht
Phone : 030 – 2533989 / 030 – 2534409
Research staff : Dr.ir. J.M. van den Akker, Prof.dr. H.L. Bodlaender, Dr. J.A. Hoogeveen, Dr. J. Nederlof, M.E. van Kooten Niekerk MSc, Dr. J.J.M. van Rooij and T.C. van der Zanden 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 – 5986010
Research staff : Annelieke Baller MSc, T. Bosman MSc, Dr. G.J. Franx, Dario Frascaria MSc, Prof.dr. J. Gromicho, Prof.dr. B. Heidergott, Maaike Hoogeboom MSc, Dr. D.A. van der Laan, Dr. R.D. Nobel, Dr. N. Olver, Dr. A.A.N. Ridder, Prof.dr. G. Schaefer, Prof dr. F.A. van der Duyn Schouten, Dr.ir. R.A. Sitters, Prof.dr. L. Stougie, Prof.dr. G.T. Timmer and M. van Ee 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 : René Bekker, Sandjai Bhulai, Ger Koole, Rob van der Mei, Bram Gorissen, Theresia van Essen, Geert Jan Kommer, Rudi Meijer, Petra Vis, Marijn ten Thij, Ruben, van de Geer, Daniel Hopman and Qingchen Wang.

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

8. LNMB certificated persons (298)

J.J. Aarts
J.M. van den Akker
E.S. Badila
T.C. van Barneveld
P.L-J. van den Berg
S. Bhulai
I.A. Bikker
C.A. Boer
N.J. Borgman
Y. Boulaksil
H.C.M. Bossers
R.C.M. Brekelmans
J.J.J. van de Broek
G. Budai
N.C. Büyükkaramikli
S. Caner
S.K. Cheung
M.B. Combé
M. Cremers
S. Dabia
A.B. Dieker
E.B. Diks
C. Dobre
J.P. Dorsman
L.E. Duijzer
C.A. van Eijl
I. Endrayanto
A. Estevez Fernandez
M. Firat
J. van der Gaast
Q. Ge
J.R.G. van Gellekom
B. Gorissen
A. Grigoriev
R. de Haan
W.J.A. van Heeswijk
W. van den Heuvel
F.J. von Heymann
K.M.R. Hoen
G.-J.J.J.A.N. van Houtum
P.J.H. Hulshof
L.J.J. van Iersel
W. van Jaarsveld
J.B. Jansen
F.B.S.L.P. Janssen
B. Kamphorst
F.J.P. Karsten
R.B.O. Kerkkamp

M.A. Abidini
M.E. Angün
N. Baër
E.M. Bázsa
J. Berkhout
J.J.P.H. Bierbooms
H.M. le Blanc
K.M.J. de Bontridder
S.C. Borst
H.W. Bouma
A. Braaksma
M. van Brink
J. Bruin
A. Buijsrogge
E.J. Cahen
F. Cecchi
T.J.M. Coenen
U. Corbacioglu
F.C.A.M. Cruijssen
K. Dalmeijer
B.J. Dietzenbacher
S. Ding
M.K. Dogru
A.B. Dragut
M. van Ee
E. Elabwabi
J. Ensinck
L. Evers
S.T.G. Fleuren
O. Gabali
R. van de Geer
K. Glorie
F.N. Gouweleeuw
E.A. Grigorieva
A. Haesel
C.J.H. Hendriksen
I. van Heuven van Staereling
A. Hristov
W.L.F. van der Hoorn
S. Huijink
E. van der Hurk
V.C. Ivanescu
C.J. Jagtenberg
M. Jansen
J. de Jong
R.P. Kampstra
B. Kaynar
O.A. Kilic

F. Ahmed
A. Asadi
X. Bai
R. Bekker
G. Bet
M. Bijvank
J.M. Bloemhof – Ruwaard
N.K. Boots
R.J. Boucherie
P.C. Bouman
G.M. te Brake
M.P. de Brito Peirera Maduro
S.P.J. van Brummelen
A. Bump
M. Calinescu
D. Chaerani
H. Cetinay
K. Cornelissen
G. Csapó
Q. Deng
A.S. Dijkstra
A.M. Dobber
T. Dollevoet
J. Driessen
R. Egorova
M. Elghami
J.T. van Essen
Y. Feng
M. Frolkova
J. Ge
S.M. Geervliet
J.-W. Goossens
R.M.P. Goverde
G. Gu
R. Haijema
D. den Hertog
B. Heydenreich
R.P. Hoeksma
W.B. van den Hout
D. Huisman
B.G.M. Husslage
I.D. Ivanov
B. Jansen
E. Janssen
B. de Jonge
A.G. Karaarslan
B. de Keijzer
B.-E. Klaus

T. van der Klauw
E. de Klerk
G.M. Koole
P. Korteweg
P. Kovács
M.G.C. van Krieken
C.M.H. Kuijpers
T. Le Anh
R.L.M.J. van Leensel
H.L. Liem
J.A. Loeve
J.M.W. van Loon
M.R.H. Mandjes
B. Marchal
P.J.M. Meersmans
R.D. van der Mei
G. Mincsovics
M. Mnich
L. van Norden
N.J. Olieman
D. van Ooteghem
P. Ouwehand
K. Pak
L.W.P. Peeters
E. Porras Musalem
M. Pourakbar
M. Quant
J.H. Reijnierse
W. Romeijnders
A. Roubos
J.H.G.C. Rutten
L.P.J. Schlicher
B. Serbetci
B.P. Silalabi
E. Smeitink
S.R. Smits
P.F. Spaans
J.M. Spitter
S. van der Ster
D. Tas
V. Timmermans
M.J.G. van Uitert
N. Usotskaya
K. Vandyshev
E.J.M. van der Veen
C. Verhoef
A.M. Verweij
I.F.A. Vis
M.J. Kleijn
F. Klijn
J. de Kort
A.M.C.A. Koster
S. Kovaleva
D. Krushinsky
C.M. Laan
T. Le Duc
D. van Leeuwen
P. Lieshout
E.R.M.A. Lohmann
F.J.W. Lutgens
H. Mansouri
N.A.A. Marquinie
M.A. Meertens
W.J.M. Meuffels
D.I. Miretskiy
J. Mulder
R. Núñez Queija
M. Oosten
G.J.M. Otten
Ö. Özdemir
O. Passchier
N. Piersma
S.A. Pot
D.R.J. Prak
A.J. Quist
G. Rennen
D. Romero Morales
D. Roubos
J.H.J. van Sambeeck
B. Selçuk
D. Sever
A. Sleptchenko
J. Smeltink
M. Sol
F.C.R. Spieksma
N.J. Starreveld
J.F. Sturm †
M. Tennekes
D.D. Tönissen
A. Ule
R.J.M. Vaessens
S.G. Vanneste
M. Veenstra
M. Verloop
A.P.A. Vestjens
P. Vis
J. Kleppe
A.L. Kok
N. Kortbeek
M. Koster
A.F. van der Kraaij
B.H.M. Kuijpers
R. Langestraat
A.G. Leeftink
S. Li
O. Listes
R.B. Lok
M. Mainegra Hing
S. Marban
B.W.J. Mathijsen
F.J.C. van Megen
T.M.M. Meyfroyt
M. Mitici
R. Nicolai
M.C.A. Olde Keizer
C.D. van Oosterom
P. Out
U. Özen
J.J. Paulus
P.C. Pop
D. Potthoff
X. Qiu
G. Regts
M. Retel Helrich
J.M.M. van Rooij
J. Rutten
J. Sanders
J. Selen
A.Y.D. Siem
M. Slikker
M.A.J. Smith
M.J. Soomer
R. Spliet
M.H. Streutker
Z. Sun
R.H. Teunter
M. Udenio
R. van Urk
P.T. Vanberkel
E. Vatamidou
H.J.J. Verheijen
A.J. Vermeulen
M. Vieira
M. Vlasiou

M.H. van der Vlerk	I. Vliegen	A. van Vliet	A. Zocca
J.P.A. van Vliet	Y. Volkovich	T. Vredeveld	A.P. Zwart
H. de Vries	M.J.C.M. Vromans	N.M. van de Vrugt	
M. van Vuuren	X. Wang	M. Wennink	
W. van der Weij	A.C.C. van Wijk	R. Wildeman	
E.M.M. Winands	R. Yang	Z. Yang	
Q.C. Ye	T. Yuan	J. Zhen	
Q. Zhu	Q.C. Zhu	A. Zocca	
M.E. Zonderland	C.M. Zwaneveld	A.P. Zwart	

9. List of Members, PhD students and Alumni

List of the members, PhD students and alumni of the LNMB are available on
http://www.lnmb.nl/pages/people