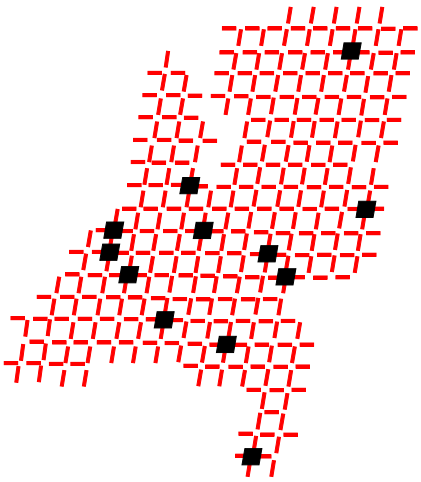

DUTCH NETWORK ON THE MATHEMATICS OF OPERATIONS RESEARCH (LNMB)

MASTER AND PhD PROGRAMME IN OPERATIONS RESEARCH

Information Guide 2018/2019

May 2018

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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 2018/2019 consists of the following courses.

Master courses:
Fall 2018:
– Continuous Optimization;
– Discrete Optimization;
– Heuristic Methods in Operations Research.
Spring 2019:
– Advanced Linear Programming;
– Scheduling;
– Queueing Theory.

PhD courses:
Trimester 1:
– Multi-class Queues and Stochastic Network;
– Networks and Polyhedra;
– Convex Analysis for Optimization.
Trimester 2:
– Networks and Semidefinite Programming;
– Algorithmic Methods in Queueing Theory;
– Cooperative Games.
Trimester 3:
– Randomized Algorithms;
– Markov Decision Processes;
– OR-Games.

Besides information about the LNMB courses, this guide contains:
− organisational and administrative affairs;
− information about the operations research groups at the Dutch universities;
− links to 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 44th Lunteren Conference on the Mathematics of Operations Research. This conference will be held 14 – 16th January 2019.

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

Johann Hurink,
Director LNMB
May, 2018

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 125 members and 253 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 2018/2019

During the academic year 2018/2019 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 10 – November 12)
- Multi-class Queues and Stochastic Networks (MQSN) Boucherie
- Networks and Polyhedra (NP) Olver
- Convex Analysis for Optimization (CAO) Brinkhuis/Postek

Trimester 2: (November 19 – December 17 and January 21 – February 18)
- Networks and Semidefinite Programming (NSP) Laurent
- Algorithmic Methods in Queueing Theory (AlQT) Kapodistria/van der Mei
- Cooperative games (CG) Borm

Trimester 3: (February 25 – April 15 and April 29 – May 6)
- Randomized Algorithms (RA) Bansal/Sitters
- Markov Decision Processes (MDP) Spieksma
- OR-Games (ORG) Hamers

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

	Trimester 1	Trimester 2	Trimester 3
11.00 – 11.45	Course MQSN	Course NSP*	Course RA*
12.00 – 12.45	Course MQSN	Course NSP*	Course RA*
12.45 – 13.15	Lunch break	Lunch break	Lunch break
13.15 – 14.00	Course NP*	Course AIQT	Course MDP
14.15 – 15.00	Course NP*	Course AIQT	Course MDP
15.15 – 16.00	Course CAO	Course CG	Course ORG
16.15 – 17.00	Course CAO	Course CG	Course ORG

* = 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 MQSN: "Multi-class Queues and Stochastic Networks"

Time : Monday 11.00 – 12.45 (September 10 – November 12)
Location: Mathematical Building, Room 611AB, Budapestlaan, Utrecht (De Uithof)
Lecturers: Prof.dr. R.J. Boucherie (UT)

Course description:
Complex stochastic systems, like communication systems, computer networks and manufacturing systems, may often be modeled as queueing networks with multiple nodes and/or multiple classes. The performance of these systems may be evaluated in terms of queue lengths, sojourn times or blocking probabilities. This course focuses on basic queueing networks for which performance measures can be obtained in closed form. First, the course focuses on a class of networks where the equilibrium distribution has a so-called product-form solution. Topics include the output theorem, reversibility, partial balance, quasi reversibility and product-form. Examples include Jackson networks, Kelly-Whittle networks, BCMP networks, loss networks and processor sharing networks. Second, the course considers the sojourn time distribution in simple networks. Third, computation of performance measures often requires effcient algorithms. To this end, Mean Value Analysis and approximation techniques will be studied.

Detailed content:
– reversibility, stationarity, basic queues, output theorem, feedforward networks;
– partial balance, Jackson network, Kelly-Whittle netwerk, arrival theorem;
– quasi-reversibility, customer types, BCMP networks, bandwidth sharing networks;
– blocking, aggregation, decomposition;
– loss networks, insensitivity via supplementary variables;
– sojourn time distribution in networks;
– MVA, AMVA, QNA.

Course information:
See: https://www.utwente.nl/ewi/sor/about/staff/boucherie/Education/mqsn/

Literature:
– R. Nelson, Probability, Stochastic Processes and Queueing Theory, 1995 : Chapter 10;
– F.P. Kelly, Reversibility and Stochastic Networks, Wiley, 1979 (available on-line);
– R.W. Wolff, Stochastic Modeling and the Theory of Queues, Prentice Hall, 1989;
– R.J. Boucherie, N.M. van Dijk (editors), Queueing Networks - A Fundamental Approach, International Series in Operations Research and Management Science Vol 154, Springer, 2011;
– handouts, slides and references to relevant additional literature will be made available at the lectures.

Prerequisites:
The participants should have followed courses in probability theory, stochastic processes and queueing theory.

Examination:
Take home problems.

Address of the lecturer:
Prof.dr. R.J. Boucherie
Dept. of Applied Mathematics, Faculty EEMCS, University of Twente
P.O. Box 217, 7500 AE Enschede
Phone: 053 – 489 3432 E-mail: r.j.boucherie@utwente.nl

Course NP: "Networks and Polyhedra"

Time: Monday 13.15 – 15.00 (September 10 – November 12)
Location: Mathematical Building, Room 611AB, Budapestlaan, Utrecht (De Uithof)
Lecturer: Dr. N.K. Olver (VU & CWI)

Course description:
Combinatorial optimization problems are concerned with the efficient allocation of limited resources to meet desired objectives when the values of the variables are restricted to be integral. They arise in a wide variety of applications, e.g. airline crew scheduling, manufacturing, network design, cellular telephone frequency design and optimization problems on graphs.

The course will discuss efficient (polynomial time) algorithms for a a number of fundamental combinatorial optimization problems involving networks. But a focus will be on the geometric viewpoint, which provides a consistent and unifying approach to the subject.

The following subjects will be discussed:

– polytopes, polyhedra, Farkas' lemma and linear programming;
– the geometric viewpoint on combinatorial optimization;
– shortest paths and trees;
– matchings and covers in bipartite graphs;
– Menger's theorem, flows and circulations;
– non-bipartite matching.

Literature:
– lecture notes: A Course in Combinatorial Optimization, A. Schrijver, CWI (chapters 1-5);
– B. Korte and J. Vygen, Combinatorial Optimization, 2e edition, Springer 2001;
– A. Schrijver, Combinatorial Optimization: Polyhedra and efficiency, Volume A: Paths, Flows, Matchings, Springer 2003.

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

Examination:
Take home problems.

Address of the lecturer:
Dr. Neil Olver
School of Business and Economics, VU University Amsterdam
De Boelelaan 1105, 1081 HV Amsterdam
Phone: 020 – 5986010 E-mail: n.olver@vu.nl

Course CAO: "Convex Analysis for Optimization"

Time : Monday 15.15 – 17.00 (September 10 – November 12)
Location: Mathematical Building, Room 611AB, Budapestlaan, Utrecht (De Uithof)
Lecturer: Dr. J. Brinkhuis (EUR) and Dr. K.S. Postek (EUR)

Course description:
Convexity plays an important role in optimization, particularly in nonlinear optimization. Many applications of optimization problems are nonlinear but have the convexity property. For convex optimization an elegant mathematical theory can be developed, including a duality theory and algorithmic aspects.

Key words for the course are: convex sets and functions; separation theorems; subdifferential calculus; polarity; Karush-Kuhn-Tucker theorem; duality; minimax results in game theory; optimal consumption and investment in economics.

Literature:
Lecture notes will be provided. In addition (also as indication for the level):
– M.S. Bazaraa, H.D. Sherali and C.M. Shetty, Nonlinear programming, theory and algorithms, 2nd edition, Wiley, 1993;
– Borwein, J. and A.S. Lewis, Convex analysis and nonlinear optimisation, 2nd edition, Springer-Verlag, New York, 2006;
– R.T. Rockafellar, Convex analysis, Princeton University Press, 1970.

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

Examination:
Take home problems.

Addresses of the lecturers:
Dr. J. Brinkhuis
Dept. of Econometrics, Faculty of Economics, Erasmus University Rotterdam
P.O. Box 1738, 3000 DR Rotterdam
Phone: 010 – 408 1364 E-mail: brinkhuis@few.eur.nl

Dr. K.S. Postek
Department of Econometrics, Erasmus School of Economics, Erasmus University Rotterdam
P.O. Box 1738, 3000 DR Rotterdam
Phone: 010 - 408 2865 E-mail: postek@ese.eur.nl

Course NSP: "Networks and Semidefinite Programming"

Time : Monday 11.00 – 12.45 (November 19 – December 17 and January 21 – February 18)
Location: Mathematical Building, Room 611AB, Budapestlaan, Utrecht (De Uithof)
Lecturer: Prof.dr. M. Laurent (CWI & TiU)

Course description:
Combinatorial optimization problems are concerned with the efficient allocation of limited resources to meet desired objectives when the values of the variables are restricted to be integral. Such problems arise in various applications, e.g., airline crew scheduling, manufacturing, network design, cellular telephone frequency design, and they can often be modeled as optimization problems on graphs. The course deals with several basic combinatorial optimization problems. While these problems are intrinsically hard to solve in general, we will present polynomial-time solvable instances. Algorithms use combinatorial tools, linear and semidefinite programming.

The following subjects are discussed:
– problems, algorithms and running time; basics of semidefinite programming;
– cliques, cocliques and colouring in graphs; Lovász theta number;
– cuts and metrics; multicommodity flows and disjoint paths.

Literature:
– lecture notes: A Course in Combinatorial Optimization, A. Schrijver, CWI (chapters 6,7,9);
– additional lecture notes on chosen topics will be provided;
– A. Schrijver, Combinatorial Optimization: Polyhedra and efficiency, Volumes A, B, and C, Springer 2003.

Prerequisites:
Basic knowledge of linear algebra, graph theory and linear programming.

Examination:
Take home problems.

Address of the lecturer:
Prof.dr. M. Laurent
CWI, P.O. Box 94079, 1090 GB Amsterdam
Phone: 020 – 5924105 E-mail: m.laurent@cwi.nl

Course AIQT: "Algorithmic Methods in Queueing Theory"

Time : Monday 13.15 – 15.00 (November 19 – December 17 and January 21 – February 18)
Location: Mathematical Building, Room 611AB, Budapestlaan, Utrecht (De Uithof)
Lecturer: Dr. S. Kapodistria (TU/e) and Prof.dr. R.D. van der Mei (VU & CWI)

Course description:
This course focusses on algorithmic aspects of queueing theory, and builds on the basic queueing models treated in the Master course Queueing Theory. Typically, queueing systems can be described by appropriately defined Markov processes. The course starts by treating numerical methods to solve the steady-state and transient behavior of (finitestate) Markov processes. Attention is also devoted to the construction of (error) bounds on the steady-state distribution. Then the course introduces elements that enrich the basic queueing models, such as Markovian arrival processes, and phase-type service times. Inclusion of such elements usually results in multi-dimensional Markov processes on a strip (i.e., one in finite dimension). Techniques to analyse the steady-state distribution of Markov processes on a strip include: spectral expansion, matrix-analytic and generating function techniques for the analysis of G/M/1-type and M/G/1-type Markov processes. Further, the course addresses several techniques to analyse Markov processes with two (or more) infinite dimensions, such as the compensation method, the power series method and the generating function (or boundary value) method. Finally, topics such as the (numerical) inversion of generating functions and Laplace transforms are discussed.

Detailed content:
– direct and iterative methods for the solution of the equilibrium equations;
– Markov processes on a strip;
– G/M/1-type models, M/G/1-type models;
– matrix-analytic methods;
– spectral expansion;
– generating function (or boundary value) method;
– compensation method;
– power series method;
– numerical inversion of generating functions and Laplace transforms.

Literature:
Handouts, slides and references will be made available at the lectures (see webpage).

Prerequisites:
The participants should have followed courses in probability theory, stochastic processes and queueing theory.

Examination: Take home problems.

Addresses of the lecturers:
Dr. S. Kapodistria
Dept. of Mathematics & Computer Science, Eindhoven University of Technology
P.O. Box 513, 5600 MB Eindhoven
Phone: 040 – 2475825 E-mail: s.kapodistria@tue.nl

Prof.dr. R.D. van der Mei
Faculty of Sciences, Department of Mathematics, Vrije Universiteit Amsterdam
De Boelelaan 1081a, 1081HV Amsterdam
Phone: 020-5987628 E-mail: mei@few.vu.nl

Course CG: "Cooperative Games"

Time : Monday 15.15 – 17.00 (November 19 – December 17 and January 21 – February 18)
Location: Mathematical Building, Room 611AB, Budapestlaan, Utrecht (De Uithof)
Lecturer: Prof.dr.ir. P.E.M. Borm (TiU)

Course description:
Game theory studies interactive decision situations involving conflict and/or cooperation. In cooperative games binding agreements are allowed and the players may form coalitions. The focus is on the question how to reallocate the resulting joint coalitional payoff among the players in a fair way.

The following subjects are discussed:
– games in characteristic form (TU games);
– shapley value, compromise value and nucleolus;
– core concepts;
– convexity and compromise stability;
– some classes of OR Games: minimum cost spanning tree games and linear production games.

Literature:
Lecture notes will be provided.
NOT compulsory (just as an indication):
– S.H. Tijs, Introduction to Game Theory, Hindustan Book Agency, India, 2003.

Prerequisites:
Basic knowledge of analysis and linear algebra.

Examination:
Take home problems.

Address of the lecturer:
Prof.dr. P.E.M. Borm
Dept. of Econometrics & Operations Research, Tilburg University
P.O. Box 90153, 5000 LE Tilburg
Phone: 013 – 4663026 E-mail: p.e.m.borm@uvt.nl

Course RA: "Randomized Algorithms"

Time: Monday 11.00 – 12.45 (February 25 – April 15 and April 29 – May 6)
Location: Mathematical Building, Room 611AB, Budapestlaan, Utrecht (De Uithof)
Lecturers: Prof.dr. N. Bansal (CWI & TU/e) and Dr. R.A. Sitters (VU & CWI)

Course description:
Randomness has proven itself to be a useful resource for developing provably efficient algorithms and protocols. This course will explore examples from a variety of settings and problem areas such as graph algorithms, algorithms in algebra, approximate counting, probabilistically checkable proofs, algorithms for big data, and matrix algorithms. Topics also include an introduction to tools from probability theory, including matringales, Chernoff bounds and Lovasz Local lemma.

Prerequisites:
Elementary knowledge of probability theory.

Examination:
Take home problems.

Addresses of the lecturers:
Prof.dr. N. Bansal
Networks and Optimization Group, CWI
Science Park 123, 1098 XG Amsterdam
Phone: 020-5924386 E-mail: N.Bansal@cwi.nl

Dr.ir. R.A. Sitters
Dept. of Econometrics and Operations Research, Faculty of Economics & Business Administration
VU University Amsterdam
De Boelelaan 1105, 1081 HV Amsterdam
Phone: 020 – 5989391 E-mail: rsitters@feweb.vu.nl

Course MDP: "Markov Decision Processes"

Time: Monday 13.15 – 15.00 (February 25 – April 15 and April 29 – May 6).
Location: Hans Freudenthalgebouw, Room 611AB, Budapestlaan, Utrecht
Lecturers: Dr.ir. F.M. Spieksma (UL).

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.

Address of the lecturer:
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 ORG: "OR-Games"

Time: Monday 15.15 – 17.00 (February 25 – April 15 and April 29 – May 6)
Location: Mathematical Building, Room 611AB, Budapestlaan, Utrecht (De Uithof)
Lecturers: Prof.dr. H.J.M. Hamers (TiU)

Course description:
The aim of this course is to provide a general overview of the possibilities of analyzing various OR-situations from a game theoretic perspective. A large part of the course is motivated by the idea that joint OR-problems in which various decision makers are involved not only have an optimization aspect in generating e.g. minimal total joint costs but as an allocation aspect in dividing these costs back fairly to the individuals itself.

Global scheme:
– a global survey of relevant notions from both cooperative and non-cooperative game theory;
– applications to bankruptcy, cost sharing, fixed and spanning tree, traveling salesman, Chinese postman, assignment, permutation, scheduling, lot sizing and inventory situations.

Literature:
Course material:
– handouts will be provided during the course;
– further reading: Curiel, I. (1997). Cooperative game theory and applications. Kluwer Academic Publishers.

Prerequisites:
The course is intended to be accessible without specific knowledge of game theory. For this aim the first part of the course will survey the game theoretical concepts that are needed.

Examination:
One final assignment to model and analyze a self-selected OR problem from a game theoretical perspective.

Address of the lecturer:
Prof.dr. H.J.M. Hamers
CentER for Economic Research, Tilburg University
P.O. Box 90153, 5000 LE Tilburg
Phone: 013 – 4662660 E-mail: h.j.m.hamers@uvt.nl URL: http://center.uvt.nl/staff/hamers

5. Master courses 2018/2019

During the academic year 2018/2019 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 2018 (September 10 – December 3):
– CO (Continuous optimization);
– DO (Discrete optimization);
– HEU (Heuristic Methods in Operations Research).

Spring 2019 (February 4 – May 6):
– ALP (Advanced linear programming);
– SCH (Scheduling);
– QT (Queueing theory).

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

	Fall 2018	*Spring 2019*
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 10 – December 3)
Location: Utrecht (De Uithof)
Lecturer: Dr. P.J.C. Dickinson (UT)

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 10 – December 3)
Location: Utrecht (Uithof)
Lecturer: Dr. B.Manthey (UT), Prof.dr. M. Uetz (UT)

Addresses of the lecturers:
Dr. B. Manthey
Dept. of Applied Mathematics, Faculty EEMCS, University of Twente
P.O. Box 217, 7500 AE Enschede
Phone: 053 – 4893385 E-mail: b.manthey@utwente.nl

Prof.dr. M. Uetz
Dept. of Applied Mathematics, Faculty EEMCS, University of Twente
P.O. Box 217, 7500 AE Enschede
Phone: 053 – 4893402 E-mail: m.uetz@utwente.nl

Course HEU “Heuristic Methods in Operations Research”

Time : Monday 15.15 – 17.00 (September 10 – December 3)
Location: Utrecht (De Uithof)
Lecturers: Prof.dr. J.L. Hurink (UT), Dr. J.M.J. Schutten (UT)

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

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 SCH: “Scheduling”

Time : Monday 11.00 – 12.45 (February 4 – May 6)
Location: Utrecht (De Uithof)
Lecturers: Prof.dr. J.L. Hurink (UT), Dr.ir. J.T. van Essen (TUD)

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

Dr. ir. J.T. van Essen
Delft Institute of Applied Mathematics, Delft University of Technology
Van Mourik Broekmanweg 6, 2628 XE Delft
Phone: 015 – 2785764 E-mail: j.t.vanessen@tudelft.nl

Course ALP: "Advanced Linear Programming"

Time : Monday 13.15 – 15.00 (February 4 – May 6)
Location: Utrecht (De Uithof)
Lecturers: Prof.dr. L. Stougie (VU), Dr.ir. J.M. van den Akker (UU)

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 QT: "Queueing Theory"

Time : Monday 15.15 – 17.00 (February 4 – May 6)
Location: Utrecht (De Uithof)
Lecturers: Dr. J.L. Dorsman (UvA), Dr.ir. W.R.W. Scheinhardt (UT)

Addresses of the lecturers:
Dr. J.L. Dorsman
Faculteit der Natuurwetenschappen, Wiskunde en Informatica, Universiteit van Amsterdam
Postbus 94248, 1090 GE Amsterdam
Phone: 020 – 5258209 and 020 – 5255217 E-mail: J.L.Dorsman@uva.nl

Dr. W.R.W. Scheinhardt
Dept. of Applied Mathematics, Faculty EEMCS, University of Twente
P.O. Box 217, 7500 AE Enschede
Phone: 053 – 4893832 E-mail: w.r.w.scheinhardt@utwente.nl URL: http://www.math.utwente.nl/~scheinhardtwrw

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.	TiU	Operations Research	Sotirov
4b.	TiU	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	Spieksma
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 : Georgios Amanatidis, Krzysztof Apt,
Nikhil Bansal, Ruben Brokkelkamp, Daniel Dadush, Dario Frascaria, Bert Gerards,
Sander Gribling, Sophie Huiberts, Dylan Huizing, Pieter Kleer, Monique Laurent, Neil Olver,
Lex Schrijver, Guido Schäfer, Rene Sitters and Yllka Velaj.

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. Ghazanfari,
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 : Prof.dr. F. Thuijsman
Address : Department of Data Science and Knowledge Engineering, Maastricht University, P.O. Box 616, 6200 MD Maastricht.
Phone : 043 – 3883489
Research staff : Dr. P. Bonizzi, Dr. R. Cavill, Dr. P.J. Collins, Dr. J.M.H. Karel, Ddr. S.M. Kelk, Dr.ir. J. Kuipers, Dr. M. Mihalak, Prof.dr.ir. R.L.M. Peeters, Dr. G.M. Schoenmakers, K. Schüller MSc, Dr. G. Stamoulis, Dr. K. Stanková, Prof.dr. F. Thuijsman 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 – 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, R. Bu, M. van Engelen, Dr.ir. J.T. van Essen, Dr. F.M. de Oliveira Filho, Dr. D. Gijswijt, Dr.ir. L.J.J. van Iersel, R. Janssen, T.M.L. Janssen, Dr. M.E.L. Jones, Prof.dr. E. de Klerk, Y. Murakami, J. Pierotti, Dr. H.N. Post, Prof.dr.ir. C. Roos and Dr.ir. J.H. 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 : Prof.dr. F.C.R. Spieksma
Address : Dept. of Mathematics and Computer Science, Eindhoven University of Technology
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Research staff : Prof.dr. N. Basal, Dr.ir. C.A.J. Hurkens, Dr. J. Nederlof, Dr. R.A. Pendavingh and Prof.dr. F.C.R. Spieksma.

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
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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)
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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 – 4896619 (secretary Uetz)
Research staf : X. Bai (PhD student), I.A. Bikker (PhD student), Prof.dr. R.J. Boucherie, J. Bos (PhD student), Dr. A. Braaksma, A. Buijsrogge (PhD student), Dr. P.J.C. Dickinson, Prof.dr. N.M. van Dijk, 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, S. Klootwijk (PhD student), C. Laan (PhD student), X. Li (PhD student), Prof.dr. M.N.M. van Lieshout, Prof.dr. N. Litvak, Dr. B. Manthey, A. Oblakova (PhD student), Dr. J.C.W. van Ommeren, J.W.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), Dr. A. Skopalik, W. van der Sluis (PhD student), P. Sun (PhD student), Dr. J.B. Timmer, E.R. Tsai (PhD student), Prof.dr. M. Uetz, B. Vieira (PhD student), Dr.ir. N.M. van de Vrugt and Dr. M. Zonderland.

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, queueing 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;
7. Data Science:
– Information theory, complex networks, spatial statistics.

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
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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
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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 and Prof.dr. G.T. Timmer.

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
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Phone : 020 – 5987755
Research staff : René Bekker, Sandjai Bhulai, Ger Koole, Rob van der Mei, Elenna Dugundji, Marijn ten Thij, Ruben van de Geer, Daniel Hopman, Qingchen Wang, Nicos Starreveld, Corné de Ruijt, Jaap Storm, Maik Couwenberg and April Li.

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

8. LNMB certificated persons (329)

J.J. Aarts
Abhishek
M.A. Abidini
F. Ahmed
J.M. van den Akker
M.E. Angün
A. Asadi
A. Aveklouris
E.S. Badila
N. Baër
X. Bai
T.C. van Barneveld
E.M. Bázsa
R. Bekker
P.L-J. van den Berg
J. Berkhout
G. Bet
S. Bhulai
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M. Bijvank
I.A. Bikker
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J.M. Bloemhof – Ruwaard
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K.M.J. de Bontridder
N.K. Boots
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S.C. Borst
T.N. Bosman
H.C.M. Bossers
R.J. Boucherie
Y. Boulaksil
H.W. Bouma
P.C. Bouman
A. Braaksma
G.M. te Brake
R.C.M. Brekelmans
T. Breugem
M. van Brink
M.P. de Brito Peirera Maduro
A.J. uit het Broek
J.J.J. van de Broek
J. Bruin
S.P.J. van Brummelen
G. Budai
A. Buijsrogge
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D. Chaerani
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C. Dobre
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J.P. Dorsman
A.B. Dragut
J. Driessen
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M. van Ee
R. Egorova
C.A. van Eijl
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M. Elghami
I. Endrayanto
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A. Estevez Fernandez
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Q. Ge
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S.M. Geervliet
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R.P. Kampstra

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H. Mansouri
N.A.A. Marquinie
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D.I. Miretskiy
J. Mulder
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N.J. Olieman
D. van Ooteghem
P. Ouwehand
K. Pak
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X. Qiu
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M. Retel Helrich
J.M.M. van Rooij
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J.H.G.C. Rutten
L.P.J. Schlicher
J. Selen
A.Y.D. Siem
M. Slikker
M.A.J. Smith
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Z. Sun
R.H. Teunter
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P.T. Vanberkel

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S. Li
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R.B. Lok
M. Mainegra Hing
S. Marban
B.W.J. Mathijsen
F.J.C. van Megen
T.M.M. Meyfroyt
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R. Nicolai
A. Oblakova
M. Oosten
G.J.M. Otten
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B. Serbetci
B.P. Silalabi
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J.M. Spitter
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D. Tas
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M.J.G. van Uitert
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J.M.W. van Loon
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G. Mincsovics
M. Mnich
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C.D. van Oosterom
P. Out
U. Özen
J.J. Paulus
G.J. Polinder
S.A. Pot
D.R.J. Prak
A.J. Quist
G. Rennen
D. Romero Morales
A. Roubos
J. Rutten
J. Sanders
B. Selçuk
D. Sever
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J. Smeltink
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N.J. Starreveld
J.F. Sturm †
M. Tennekes
D.D. Tönissen
A. Ule
R.J.M. Vaessens
S.G. Vanneste

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A.J. Vermeulen	A.M. Verweij	A.P.A. Vestjens
M. Vieira	I.F.A. Vis	P. Vis
T.R. Visser	M. Vlasiou	M.H. van der Vlerk
I. Vliegen	A. van Vliet	J.P.A. van Vliet
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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