



Scientific Report 2013

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Name of the Research Unit	(MAT-LVT-297) Centro de Matemática e Aplicações – CMA
Coordinator	Maria Luísa Martins Macedo de Faria Mascarenhas
Main Scientific Domain	Mathematics

Leading Host Institution: Faculdade de Ciências e Tecnologia – Universidade Nova de Lisboa.

1. Objectives & Achievements

1.1. Unit Description

CMA/FCT/UNL is located at Faculdade de Ciências e Tecnologia of Universidade Nova de Lisboa (FCT/UNL) at Caparica Campus and occupies two large rooms on the first floor of building VII, where is also located the Department of Mathematics (DM).

CMA/UNL has 61 Ph.D. active researchers and 11 internal collaborators. The center is organized into four research groups (teams - see Figure 1):

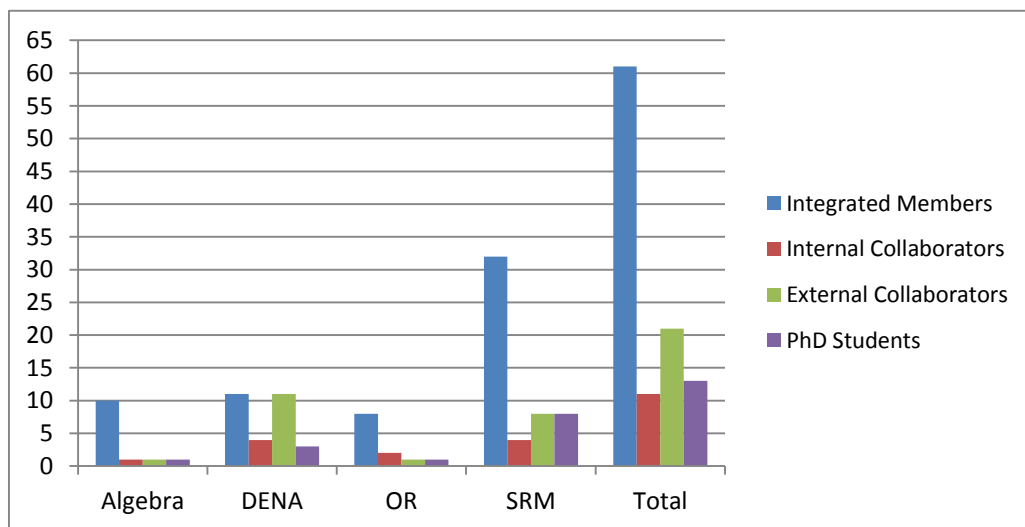


Figure 1 – CMA internal structure.

- Algebra (A)
- Differential Equations and Numerical Analysis (DENA)
- Operations Research (OR)
- Statistics and Risk Management (SRM)

Each team has one elected coordinator, responsible primarily to guarantee that the team budget is used according to the Center's strategic project (approved by FCT). The center is led by one General Coordinator which provides leadership and guidance for the development and implementation of research orientation in accordance with the decisions of the Scientific Committee (composed by all the active Ph.D. members) and is assisted by an Executive Committee composed by the General Coordinator and three appointed members. An External Permanent Advising Scientific Committee composed by five internationally recognized high-level researchers, follows the scientific activities of the center. The secretariat of the Department of Mathematics supervises accounting and general administrative support is provided by a BGCT grant. CMA bylaw and membership requirement regulations are available in a written document, reviewed every year in order to contemplate the classification of the researchers according to productivity indicators. Funding is allocated to each team, proportionally to the corresponding number of Ph.D. active researchers.

For more information please visit the CMA/FCT/UNL web site:

<http://www.cma.fct.unl.pt>

1. 2. General Objectives

The objective of CMA/FCT/UNL is to continue to promote high-level scientific research in the areas of pure and applied mathematics and its subsequent national and international projection.

Together with the strong support provided to traditional areas in the unit, like Actuarial Science, Financial Mathematics and Statistics (team Statistics and Risk Management) and Combinatorial and Nonlinear Optimization (team Operations Research), more abstract areas are to be developed within the team Algebra, like Combinatorial Number Theory, Linear Algebra and Matrix Theory, Non-commutative Algebraic Geometry, Ockham Algebras, Semigroups, Combinatorics and Graph Theory, Discrete Geometry and Algebraic and Differential Geometrical Methods for Topological Quantum Field Theories. We have also widened the scope of our applications concerning Differential Equations and Numerical Analysis: research has been oriented to Biomathematics, Material Science and Fluid Mechanics.

An effective interaction with high level international research centers and universities, like Massachusetts Institute of Technology, Carnegie Mellon University, Univ. Texas-Austin, École Polytechnique Fédérale de Lausanne (EPFL), has been successfully promoted through direct collaboration and/or the approval of several international research projects. Also the internal interaction among the research teams is steadily increasing, always preserving their own scientific strategy. Collaboration between Operations Research and Differential Equations and Numerical Analysis already exists through optimization problems and numerical methods. Collaboration between the groups Statistics and Risk Management and Differential Equations and Numerical Analysis is leading to some issues in Financial Mathematics. To reinforce this direction and to extend it to other disciplines inside and outside the FCT/UNL, weekly seminars are organized by the different research teams. CMA/FCT/UNL collaborates with the Ph.D. and Post Doc Programs in Applied Mathematics, in the scope of CoLab University of Texas at Austin-Portugal and ICTI Carnegie Mellon University-Portugal.

Despite the enormous teaching load, our researchers generally honor their commitments and develop an interesting scientific work. In order to encourage good research practices and create adequate working conditions, we mention two goals:

- Promote, whenever it is possible, the reduction of the teaching charge for active researchers with outstanding scientific projects;
- Recover the scientific activity, through work plans, of investigators that have not met the productivity indicators referred in the unit description above.

1. 3. Main Achievements During the Year of 2013

The center was granted by two FCT exploratory projects for one year, starting in Spring of 2014. We are proud to observe that only nine projects in Mathematics were supported in all Portugal in the call of 2013. The total funding of these two projects is 49.250,00 euros, resulting in circa 22% of the total funded projects in mathematics. This was the largest share among all universities in the domain of mathematics. It is worthwhile noting that in the 2013 call the principal investigator should hold the Ph.D. degree obtained between the years of 2003 and 2009. These projects allow us to secure two research scholarships for master students.

The ClubeMath's team (Maria do Céu Soares, Fátima Rodrigues, Nelson Chibeles-Martins, Susana Baptista and Gracinda Guerreiro), representing Universidade Nova de Lisboa, was granted with the first Comenius project of FCT/UNL, funded by the European Union. The partners of this project, besides UNL, are the leader Università degli Studi di Perugia (Italy), Eotvos Lorand University (Hungary), Mathematikum Giessen E.V. (Germany) and Sheffield Hallam University (England).

The paper *Simultaneous design and planning of supply chains with reverse flows: A generic modelling framework* by M. I. Gomes Salema, A. P. Barbosa-Póvoa and A. Q. Novais received the EURO Award for the Best EJOR Paper 2013 in the category of Theory and Methodology. <http://euro-online.org/web/pages/1519/eabep-winners-2013>

During 2013, members of the Unit founded in the Campus the first national SIAM Student Chapter. The Chapter aims communication and exchange of ideas between students from different branches of Science and Engineering, potentiating interdisciplinary scientific work.

Regarding collaborations with industry, CMA has initiated a partnership with SISCOG, a logistic company that develops decision support systems for transportation companies. For this collaboration, support for two students developing their master thesis in industrial context are granted (2014-15).

Alan Cain received the "2013 Investigador FCT" grant and will join the CMA team from January 2014.

In 2013, members of the center published 38 papers in internationally peer reviewed journals, with an average of approximately 1 paper to each 2 members. See more details in section 4.

The overall scientific production of the teams can be found in Table 1:

Teams	ISI Journals		Other International Publications		PI projects	Ph.D. Completed	M.Sc. Completed
	Published	Accepted	Published	Accepted			
Algebra	8	2	2	2	1	1	0
DENA	2	2	3	4	2	0	0
OR	4	6	5	4	0	0	0
SRM	19	5	25	2	3	3	4
Total	33	15	35	12	6	4	4

Table 1 – Overall scientific production.

This shows an average of approximately 1.11 international publications (where accepted papers were not included) and 0.54 in ISI journals (where accepted papers were not included), per researcher per year. Figures 2 and 3 represent a graphical comparison between the number of publications and projects, respectively, in the years 2011, 2012 and 2013.

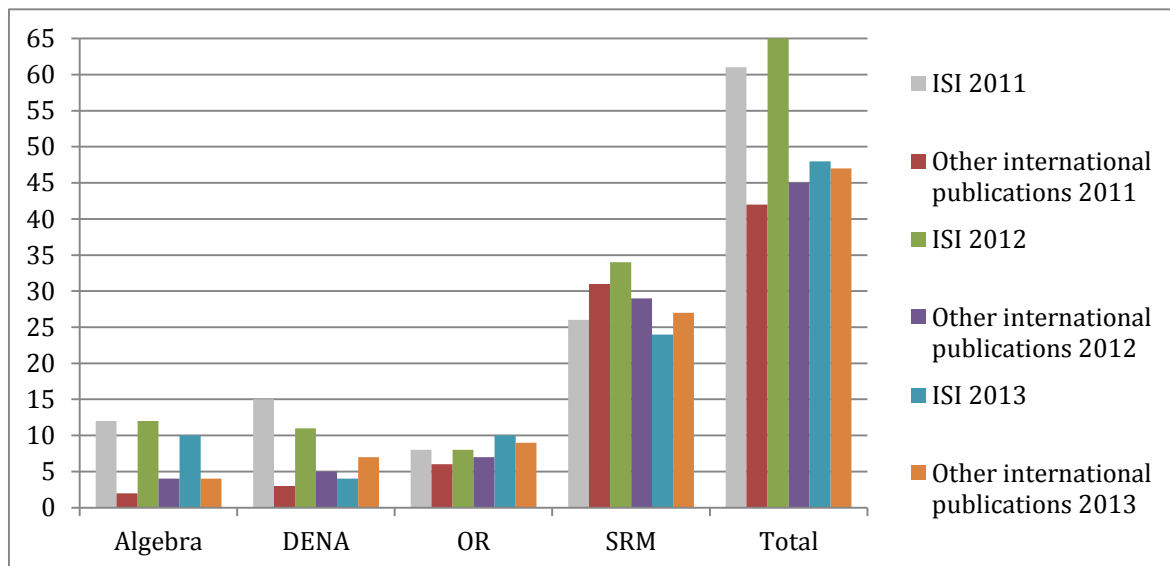


Figure 2 – Comparison between number of journal publications by CMA members, in the years 2011, 2012 and 2013.

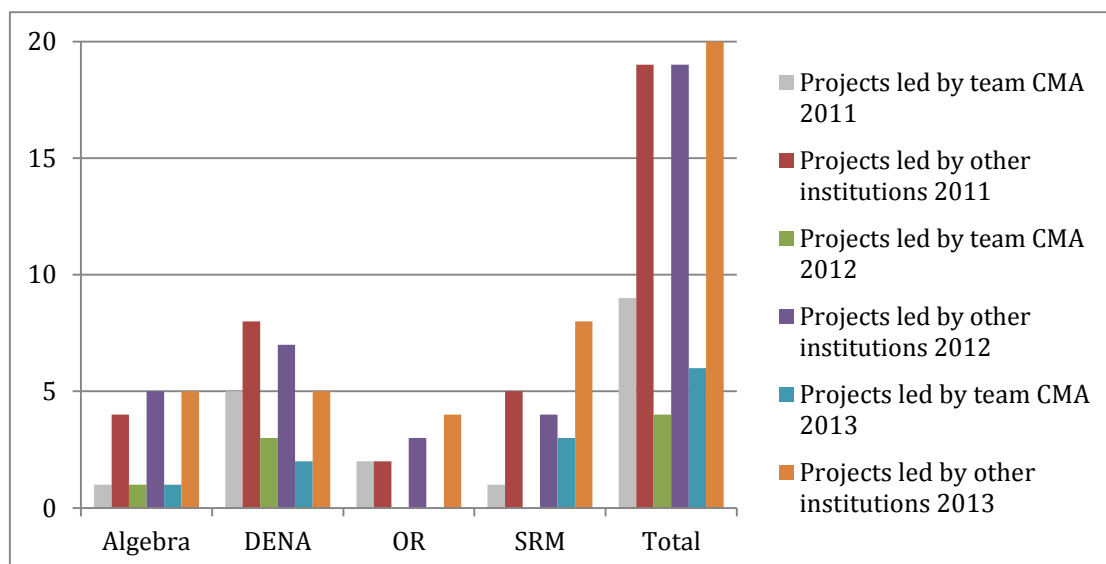


Figure 3 – Number of projects lead by CMA members and projects lead by other institutions in the years 2011, 2012 and 2013.

2. Activities

2. 1. Integrative/Multidisciplinary Activities During the Year of 2013

All research groups organize weekly seminars allowing interaction with other disciplines inside and outside FCT/UNL. Through the different research projects there were significant interactions with researchers from Mathematical Economy, Medical Schools, Agronomy and Computer Science. Several members among the researchers, collaborators, Ph.D. and M.Sc. Students, especially in team SRM and OR, develop their professional activities in connection with the industry (energy, banking, insurance, logistics) allowing very useful interactions.

Some members of the team DENA work in Biomathematics, including in Epidemiology, in collaboration with the Gulbenkian Institute of Science. Members of DENA address also problems from Fluid Mechanics, mathematical problems in Material Science, Image Reconstruction and Games Theory. The activities mentioned above are linked with the scientific projects and with the organization/participation in international meetings, described in the items Research Groups.

Our members have scientific collaborations with the main Research Centers in Portugal and with several high level foreign Universities and Research Centers.

We consolidate our participation in the Ph.D. and Post Doc Programs in Applied Mathematics, in the scope of CoLab University of Texas at Austin-Portugal and ICTI Carnegie Mellon University-Portugal.

2. 2. Outreach Activities During the Year of 2013

CMA/FCT/UNL is member of the Associação Portuguesa de Investigação Operacional (APDIO) and of the Comissão Nacional de Matemática (CNM). Collaborates with the Centro Internacional de Matemática (CIM) and with the Sociedade Portuguesa de Matemática (SPM).

We highlight some of our activities below

- The director and two regular writers of "Gazeta de Matemática" (a scientific diffusion non-profit publication by the SPM);
- The presenter of the tv show "Isto é Matemática" broadcasted by SIC Noticias, a general TV channel;

- The president of the audit committee of the SPM;
- A member of the Education Committee of the Portuguese Institute of Actuaries;
- A co-founder of the Section of Young Statisticians, of the Portuguese Statistical Society (SPE).

Members of almost all the research groups participate in the following projects, all promoted by CMA/FCT/UNL members, exception made for the last two items. Those projects involve scientific divulgation or special training in mathematics, addressed to young students from schools:

- ClubeMath (<http://eventos.fct.unl.pt/clubemath>);
- Conferences "Implica Matemática" (<http://eventos.fct.unl.pt/implica-matematica>);
- DivMAT (<https://sites.google.com/site/divmatfct/home/o-grupo-divmat>);
- ESCOLA ALEPH (<http://aleph.ptmat.fc.ul.pt>);
- ExpoFCT (<http://eventos.fct.unl.pt/expofct>);
- Summer School MatNova 2013 (<http://eventos.fct.unl.pt/matnova2013>);
- Scientific diffusion in high schools;
- Several lectures for students or general public.

The current exhibition MATER, about Mathematics and Time, Space, Life, Art and Daily life, in the Caparica Campus, provides guided tours specifically dedicated to students from the local schools. As heart of the exhibition, a scale solar system reproduction, spread all over the region, was constructed and installed with the collaboration of those schools.

3. Funding

	2008	2009	2010	2011	2012	2013
LA FCT	0	0	0	0	0	0
Units FCT	68922	187688	131381	126348	126348	162504
Projects FCT	34125	34125	34125	39743	39743	65858
Other (National)	0	0	0	2850	0	0
Other (International)	0	5000	12000	9500	19965	19965
National Industry	0	0	25000	25000	0	0
International Industry	0	0	0	0	0	0
Total	103047	226813	202506	203441	186056	248327

4. General Indicators

	2007	2008	2009	2010	2011	2012	2013	Total
No. of Researchers Hired (Ciência Programme)	0	4	2	0	0	0	1	7
No. of Researchers integrated with Ph.D.	42	49	48	49	49	55	61	---
Training Ph.Ds. (Ph.D. theses completed)	12	9	7	1	1	5	4	39

Since 2008 the center has experienced a steady increase in the ratio of publications (total number of publications in peer reviewed journals per integrated member). However, the year 2013 was atypical with a strong decrease in the average number of publications in all lines. We do not advance any definitive explanation, but it may be associated to the large teaching load we are all subject to. In fact, during the academic year 2012/3, we experienced a dramatic increase in the number of optional disciplines, most of them followed by a low number of students. The teaching load associated to these disciplines is only partially counted.

	2008	2009	2010	2011	2012	2013
Publications in international peer reviewed journals	39	46	41	39	57	38
Publications in international peer reviewed journals (per member)	0.80	0.96	0.84	0.80	1.03	0.62

Teams	Number of publications (per team)	Number of publications (per member)
Algebra	10	1
DENA	2	0.18
OR	4	0.5
SRM	22	0.69

5. Technical Personnel Hired

Name	Start date	End Date
Vanda Sofia dos Santos Martins	01-04-2011	31-12-2014

6. Research Groups

Reference	Title/Principal Investigator
RG-LVT-297-1846	<u>Algebra</u> (Carlos Manuel Saiago)
RG-LVT-297-1849	<u>Differential Equations and Numerical Analysis</u> (Fabio Augusto da Costa Carvalho Chalub)
RG-LVT-297-1850	<u>Operations Research</u> (Maria Isabel Azevedo Rodrigues Gomes)
RG-LVT-297-3843	<u>Statistics and Risk Management</u> (Manuel Leote Tavares Ingles Esquivel)

6. 1. Algebra Team

Integrated Members

- Bjorn Gohla
- Carlos Manuel Saiago
- Gonçalo Jorge Trigo Nery Tabuada
- Henry Liu
- Herberto de Jesus da Silva
- Jaime da Gama Gaspar
- João Nuno Gonçalves Faria Martins
- Manuel Almeida Silva
- Maria Helena Coutinho Gomes de Almeida Santos
- Teresa Maria Jerónimo Sousa

Collaborators Members

- Isabel Oitavem Rocha
- João Leitão Guerreiro (Ph.D. student)
- Maria Cecília Perdigão Dias da Silva

6. 1. 1. Funding, Source, Dates

Projects led by team Algebra members:

	Project Title	Principal Investigator	Team Members	Period	Total Funding
1. PTDC/MAT/113207/2009	"H-decompositions of graphs: two new problems"	Teresa Maria Jerónimo Sousa	Manuel Almeida Silva and Henry Liu	2011-2014	18.000 €

Led by other institutions, with participation of team Algebra members, eventually with no budget in our institution:

	Project title	Principal Investigator	Team Members	Period	Total Funding
1. PTDC/MAT/101503/2008	"New geometry and topology"	Roger Francis Picken	João Nuno Gonçalves Faria Martins	2010-2013	120.000 € (IST and Univ. Algarve)

2. PTDC/MAT/098770/2008	"Topological invariants via differential geometry"	Peter Beier Gothen	João Nuno Gonçalves Faria Martins and Björn Gohla	2010-2013	100.000 € (FCUP)
3. PTDC/MAT/098317/2008	"Algebraic topology and applications"	Pedro Ferreira dos Santos	Gonçalo Tabuada	2009-2013	53.740 € (FFCT/UNL)
4. PTDC/MAT/112273/2009	"Inverse Problems, Eigenvalues Multiplicities and Graphs"	António José Esteves Leal Duarte	Carlos Manuel Saiago	2011-2013	26.400 € (UC)
5. EXCL/MAT-GEO/0222/2012	"Geometry and Mathematical-Physics"	Miguel Tribolet Abreu	João Nuno Gonçalves Faria Martins	2012-2017	326.000 € (IST-ID)

6. 1. 2. Objectives

The Algebra team plans to develop research in Algebraic and Differential Geometry applied to Topological Quantum Field Theory, Combinatorial Number Theory, Combinatorics and Graph Theory, Ramsey Theory, Linear Algebra and Matrix Theory, Non-commutative Algebraic Geometry, Ockham Algebras, Semigroups, and Logic. The Algebra group is also organizing regular seminars.

Integrated Members:

Carlos Saiago: Collect, review and discuss a number of questions and conjectures about multiplicity lists occurring among Hermitian matrices whose graph is a tree. This investigation will be aided by a new electronic database (in construction) containing all multiplicity lists for trees on fewer than 12 vertices. Investigate and/or present questions and conjectures, some are familiar and some are new, and if possible to give new information about them.

Gonçalo Tabuada: The main goal for 2014 is the construction of a A1-homotopy theory of noncommutative motives. This would greatly extend the current theory of noncommutative motives and allow a motivic proof of the fundamental theorem in algebraic K-theory.

Henry Liu: To continue to work on the following research projects:

1. Interval edge-colourings of graphs and hypergraphs (with Angela Mestre and Manuel Silva): a model of edge-colouring in graphs and hypergraphs is studied, where the colours correspond to 1, 2, 3,..., and at every vertex the colours of the edges correspond to an interval;
2. Degree powers in graphs forbidding certain subgraphs (with Xueliang Li, Zhongmei Qi and Yongtang Shi): A variant of the classical Turan problem is studied;
3. The k -rainbow cycle index of a graph: colour the edges of a graph with as few colours as possible so that, any k vertices are connected by a "rainbow" cycle.

Herberto Silva: Prosecute ongoing research on the following topics:

1. Congruences and ideals in Ockham algebras;
2. Strong endomorphism kernel property in Ockham algebras;
3. The lattice of subalgebras of an Ockham algebra.

Jaime Gaspar: The plan is to work (1) theoretically on the study of existing proof interpretations and on the design of new proof interpretations, and (2) appliedly on the application of proof interpretations. Provable security is an area in cryptography where we (1) rigorously define a cryptographic object, (2) rigorously define a notion of security, and then (3) rigorously prove that the cryptographic object is secure; provable security takes us from uncertain security (where we only have some empirical indication that the cryptographic object is secure) to certain security (where we even have a mathematical proof that the cryptographic object is secure).

João Faria Martins: Understand harmonic analysis for representations of categorical groups. Apply the definition of infinitesimal braidings to the categorification of quantum group representations. Definition of topological invariants from infinitesimal 2-braidings.

Manuel Silva: To work in Ramsey problems in combinatorics of words.

Maria Helena Santos: Investigate regular semigroups, and ordered semigroups.

Teresa Sousa: Develop research in graph decomposition, the main problem being that of finding the smallest number $f(n,H)$, such that, any graph on n vertices admits an decomposition into edge disjoint copies of a fixed graph H and single edges with at most $f(n,H)$ parts. Continue the study of graph decomposition as well as its Ramsey (or colored)

version, the problem where the ground graph is colored with k colors and the goal is to find an optimal monochromatic H -decomposition.

Collaborators:

Cecília Perdigão: Investigate about matrices associated with graphs and their properties.

6. 1. 3. Main Achievements

Highlights:

Jaime Gaspar:

- BITDEFENDER Postdoctoral Fellowship, Simion Stoilow Institute of Mathematics of the Romanian Academy, Romania;
- Postdoctoral grant, project The Notion of Mathematical Proof, New University of Lisbon, Portugal;
- Doctoral grant, Martí Franquès Research Fellowship Programme, Rovira i Virgili University, Spain;
- Postdoctoral grant/position, Project Dynamic Resources and Separation and Update Logics, Laboratory Lorrain of Research in Computer Science and its Applications, France;
- Travel grant to attend the Logic Colloquium 2013, German Association for Mathematical Logic and for Foundations of the Exact Sciences, Germany.

Achievements by Integrated Members:

Carlos Saiago: Using the method of seeds and branch duplication, it was shown that for every tree of diameter less than 7, there is an Hermitian matrix with as few as the diameter many distinct eigenvalues (a known lower bound) and, for diameter 7, some trees require 8 distinct eigenvalues, but no more; the seeds for which 7 and 8 are the worst case were classified. For trees of diameter d , it was shown, in general, that the minimum number of distinct eigenvalues is bounded by a function of d . It was also shown that many trees of high diameter permit as few of distinct eigenvalues as the diameter and a conjecture was made that all linear trees are of this type.

Gonçalo Tabuada: In 2013 established a precise link between the classical theory of motives developed by Grothendieck and the recent theory of noncommutative developed by Drinfeld and Kontsevich. This allowed a conceptual characterization of the twisted

algebraic K-theory introduced originally by Kahn-Levine.

Henry Liu: Five research papers were accepted or published in international journals.

Herberto Silva: Continuing the work of scientific research on Ockham algebras in the context of Universal Algebra and Lattice Theory, various problems about congruences of Ockham algebras were studied.

Jaime Gaspar: Submitted article: A proof of the formula $1 + 2 + \dots + n = n(n + 1)/2$. Letter accepted for publication: Does not suffice to run latex a finite number of times to get cross-references right, TUGboat.

João Faria Martins: Complete description of a categorical framework for infinitesimal 2-braidings, including an infinitesimal 2-braiding embedded in the string Lie-2-algebra.

Manuel Silva: Proved the existence of co-Sidon subsets from two sets of integers with small additive energy.

Maria Helena Santos: Following previous publications E-special ordered semigroups were investigated. The developed work resulted in the article entitled "E-special ordered regular semigroups" that was recently accepted for publication.

Teresa Sousa: During 2013 three papers have been published.

Achievements by Collaborators:

Cecília Perdigão:

In 2013 studied matrices associated with graphs that are not trees.

6. 1. 4. Group Productivity

6. 1. 4. 1. Publications in Peer Review Journals

1. Dubickasa, A., Schoen, T., **Silva, M.** and Šarka, P. (2013), *Finding large co-Sidon subsets in sets with a given additive energy*, European Journal of Combinatorics, 34 (7), 1144-1157 [Impact factor = 0.658].

URL: <http://www.sciencedirect.com/science/article/pii/S0195669813000577>

2. Fujita, S. and **Liu, H.** (2013), *The balanced decomposition number of TK_4 and series-parallel graphs*, Discussiones Mathematicae Graph Theory, 33 (2), 347-359.

URL: <http://www.degruyter.com/view/j/dmgt.2013.33.issue-2/dmgt.1666/dmgt.1666.xml?format=INT>

3. **Gohla B.** and **Faria Martins, J.** (2013), *Pointed homotopy and pointed lax homotopy of 2-crossed module maps*, Advances in Mathematics, 248, 986-1049 [Impact factor = 1.373].

URL: <http://www.sciencedirect.com/science/article/pii/S0001870813003125>

4. **Liu, H.** and **Sousa, T.** (2013), *Monochromatic K_r -decompositions of graphs (extended abstract)*, Electronic Notes in Discrete Mathematics, 43, 121-127.

URL: <http://dx.doi.org/10.1016/j.endm.2013.07.021>

5. **Liu, H.**, **Mestre, A.** and **Sousa, T.** (2013), *Rainbow vertex k -connection in graphs*, Discrete Applied Mathematics, 161 (16-17), 2549-2555 [Impact factor = 0.718].

URL: <http://www.sciencedirect.com/science/article/pii/S0166218X13002278>

6. **Tabuada, G.** (2013), *Chow motives versus noncommutative motives*, Journal of Noncommutative Geometry, 7 (3), 767-786 [Impact factor = 0.878].

7. **Tabuada, G.** and **Balmer, P.** (2013), *Fundamental isomorphism conjecture via noncommutative motives*, Mathematische Nachrichten, 286 (8-9), 791-798 [Impact factor = 0.576].

8. **Tabuada, G.**, **J. Blumberg, A.** and **Gepner, D.** (2013), *A universal characterization of higher algebraic K -theory*, Geometry and Topology, 17, 733-838 [Impact factor = 0.974].

9. **Tabuada, G.** (2013), *Weil cohomologies and derived dg categories*, Journal of Pure and Applied Algebra, 217 (7), 1294-1302 [Impact factor = 0.534].

URL: <http://www.sciencedirect.com/science/article/pii/S0022404912003258>

10. **Tabuada, G.** (2013), *Products, multiplicative Chern characters, and finite coefficients via noncommutative motives*, Journal of Pure and Applied Algebra, 217 (7), 1279-1293 [Impact factor = 0.534].

URL: <http://www.sciencedirect.com/science/article/pii/S002240491200326X>

6. 1. 4. 2. Papers Accepted in Peer Review Journals

1. Carpentier, R., **Liu, H.**, **Silva, M.** and **Sousa, T.** (2014), *Rainbow connection for some families of hypergraphs*, Discrete Mathematics, 327, 40-50 [Impact factor = 0.578].

URL: <http://www.sciencedirect.com/science/article/pii/S0012365X14001083>

2. **Liu, H.** and **Sousa, T.**, *Monochromatic K_r -Decompositions of Graphs*, to appear in Journal of Graph Theory [Impact factor = 0.626].

6. 1. 4. 3. Papers Submitted

1. **Faria Martins, J.** and Picken, R., *Link invariants from finite categorical groups and braided crossed modules*.

URL: <http://arxiv.org/abs/1301.3803>

2. **Gaspar, J.**, *A proof of the formula $1 \cdot 2 \cdots n = n(n-1)/2$* .

3. **Gohla, B.**, *Mapping Spaces of Gray-Categories*, submitted to Theory and Applications of Categories [Impact factor = 0.536].

URL: <http://arxiv.org/abs/1212.0496>

4. **Liu, H.** and **Sousa, T.**, *Decompositions of graphs into fans and single edges*.

5. **Liu, H.**, Mestre, A. and **Sousa, T.** (2014), *Total rainbow k -connection in graphs*, Discrete Applied Mathematics, 174, 92-101 (Received 25 September 2013, accepted 9 April 2014, available online 30 April 2014) [Impact factor = 0.718].

URL: <http://www.sciencedirect.com/science/article/pii/S0166218X14001723>

6. Cirio, L. and **Faria Martins, J.**, *Infinitesimal 2-braidings and differential crossed modules*.

URL: <http://arxiv.org/abs/1309.4070>

7. Buckley, S. P., Corliss, J. G., Johnson, C. R., Lombardía, C. A. and **Saigo, C.**, *Questions, Conjectures, and Data about Multiplicity Lists for Trees*.

8. Johnson, C. R. and **Saigo, C.**, *Diameter Minimal Trees*.

6. 1. 4. 4. Other International Publications

1. Fujita, S., **Liu, H.** and Magnant, C., *Rainbow k -connection in dense graphs*, to appear in Journal of Combinatorial Mathematics and Combinatorial Computing.
2. **Gaspar, J.**, *Does not suffice to run latex a finite number of times to get cross-references right*, to appear in TUGboat.

6. 1. 4. 5. Other National Publications

Sousa, T. (2013), *Paul Erdos faria 100 anos*, Gazeta de Matemática, 171.

URL: <http://gazeta.spm.pt/fichaartigo?id=427>

6. 1. 4. 6. Ph.D. Theses Completed

Björn Gohla

"Mapping spaces for Gray-categories", University of Oporto, 22 March 2013.

Supervisor: **João Nuno Martins**

Co-supervisor: Peter Gothen

Bjorn Gohla was recently awarded a post-doctoral fellowship from FCT and left CMA/FCT/UNL for the Group of Mathematical Physics/University of Lisbon.

6. 1. 5. Internationalization

Maria Helena Santos did collaborative research with Professor T. S. Blyth of St Andrews University.

- (i) Invited talks at international conferences

1. **Tabuada, G.**, Conference Homotopical methods in algebraic geometry, University of Southern California, June 2013.
2. **Tabuada, G.**, Conference Interactions between Noncommutative Algebra, Representation theory, and Algebraic Geometry, MSRI, Berkeley, 2013.

- (ii) Posters

Teresa Sousa presented a poster Erdos Centennial, Budapest, July 2013.

6. 1. 6. Other Important Information

(i) Activities

João Martins: Organization of Matnova2013 - Escola de Verão de Matemática (3-7 September 2013). A summer school in Mathematics for honor secondary school students.

Manuel Silva: Organization of Escola Aleph: solving mathematics problems for high school students.

(ii) Editing (of books and journals)

Teresa Sousa: Member of the editorial board Open Journal of Discrete Mathematics.

(iii) Peer-reviewing activities

Carlos Saiago:

- Referee for Discrete Mathematics.

Jaime Gaspar:

- Referee for Computer Communications;
- Referee for Transactions on Data Privacy.

João Faria Martins:

- Referee for Journal of Geometry and Physics.

Herberto Silva:

- Referee for Journal Algebra Universalis;
- Review for Mathematical Reviews/MathSciNet.

6. 2. Differential Equations and Numerical Analysis Team

Integrated Members

- Ana Margarida Fernandes Ribeiro
- Bento José Carrilho Miguens Louro
- Fabio Augusto da Costa Carvalho Chalub
- José Maria Nunes de Almeida Gonçalves Gomes
- Maria do Céu Cerqueira Soares
- Maria de Serpa Salema Reis de Orey
- Maria Luísa Martins Macedo de Faria Mascarenhas
- Oleksiy Karlovych
- Paula Cristiana Costa Garcia Silva Patrício Rodrigues
- Rita Alexandra Gonçalves Ferreira
- Rogério Ferreira Martins

Collaborators Members

- Alessandro Margheri
- Ana Cristina Melo e Sousa Albuquerque Barroso
- Ana Maria de Sousa Alves de Sá
- Ana Paula Barreira Pimenta (Ph.D. student)
- Carolin Claudia Kreisbeck
- Gonçalo Nuno Rosado Morais (Ph.D. student)
- Filipa Manuela Ventura Caetano
- João de Deus Mota da Silva Marques
- João Paulo de Carvalho Dias
- Jorge Filipe Drumond Pinto da Silva
- José Carlos Pedro Cardoso Matias
- Maria Carlota da Rocha Xavier Rebelo Gonçalves
- Maria Fernanda Alves da Veiga de Oliveira
- Mário Sequeira Rodrigues Figueira
- Paulo José Fernandes Louro Ribeiro Doutor
- Pedro Alves Martins da Silva Girão
- Luís Manuel Trabucho de Campos
- Telma Margarida Cotovio Guerra Santos (Ph.D. student)

6. 2. 1. Funding, Source, Dates

Projects led by team DENA members:

	Project Title	Principal Investigator	Team Members	Period	Total Funding
1. PTDC/MAT/109973/2009	"Optimization methods in continuum mechanics"	Maria Luísa Martins Macedo de Faria Mascarenhas	Rita Ferreira, Luís Trabucho de Campos, Bento Louro, Maria do Céu Soares, Nadir Arada, Ana Margarida Ribeiro, Maria de Serpa Orey and Telma Margarida Santos	2011-2013	70.000 € (FFCT/UNL)
2. UTA_CMU/MAT/0005/2009	"Thin structures, homogenization and multi phase problems"	Maria Luísa Martins Macedo de Faria Mascarenhas	Carolín Kreisbeck, Ana Margarida Ribeiro and Rita Ferreira	2011-2013	168.200,00 € (FCT/Portugal and Carnegie Mellon University/ USA)

Led by other institutions, with participation of team DENA members, eventually with no budget in our institution:

	Project Title	Principal Investigator	Team Members	Period	Total Funding
1. PTDC/MAT/113383/2009	"Nonlinear dynamics of ordinary differential equations and applications"	Alessandro Margheri	Rogério Ferreira Martins and Gonçalo Nuno Rosado Moraes	2011-2014	60.600 € (UL)
2. PTDC/MAT/114397/2009	"Non-linear degenerate elliptic equations and systems"	Diogo Luis de Castro Vasconcelos de Aguiar Gomes	José Maria Nunes de Almeida Gonçalves Gomes	2009-2014	78.000 € (IST)
3. UTAustin/MAT/0035/2008	"Analysis of nonlinear partial differential equations"	José Miguel Dordio Martinho de Almeida Urbano	Fabio Augusto da Costa Carvalho Chalub and Filipe Serra de Oliveira	2009-2013	100.000 € (University of Texas at Austin and FCT/Portugal) (UC)
4. UTA_CMU/MAT/0007/2009	"Degenerate elliptic and parabolic equations and its applications to"	Diogo Luis de Castro Vasconcelos de Aguiar Gomes	Fabio Augusto da Costa Carvalho Chalub	2011-2014	209.997 € (IST)

	front propagation"				
5. 539872-LLP-1-2013-1-IT-COMENIUS-CMP	"MiMa-Mathematics in the Making"	Emmanuela Ughi (Università degli Studi di Perugia-Italy)	Susana Baptista(*), Nelson Chibeles-Martins(*), Gracinda Guerreiro(**) and Maria do Céu Soares	2013-2014	369.851 €

(*) – Member of the OR team participating in this project.

(**) – Member of the SRM team participating in this project.

6. 2. 2. Objectives

The objective of DENA group is to continue to promote high-level scientific research in the area of analysis (in the broad sense) and its applications to Biomathematics, Material Science and Fluid Mechanics. We plan to continue existing research projects as well as start new collaborations.

Here we would like to emphasize two new exploratory projects funded by FCT in 2014-2015. One is "Game theory and epidemiology" leaded by Paula Rodrigues and the other is "Variational problems in variable exponent Sobolev spaces" leaded by Ana Margarida Ribeiro. These projects are results of emerging collaboration within the group. They will be performed by dynamic teams of researchers representing the majority of our group.

One of the main aims of the group is to increase its scientific productivity. We hope that new and emerging collaborations will help us in this difficult task. There are several positive factors, which should influence our productivity in the short term period: Fabio Chalub is free from teaching duties till 2018 thanks to FCT Investigator grant, Alexei Karlovich is on sabbatical leave in 2014, two senior members of our group (Bento Louro and Luísa Mascarenhas) were recently retired from teaching duties. 2014 is a transitional year for our group. Starting from 2015 several new members will join the group: Luís Trabucho, Magda Rebelo, Nuno Martins, Fernanda Cipriano Marques, Filipe Oliveira and Nadir Arada. We continue to look for new synergies with researchers which will join CMA in 2015.

Alexei Karlovich jointly with Yu. Karlovich and A. Lebre are going to establish an index formula for singular integral operators with slowly oscillating shifts.

Alexei Karlovich is going to prove some boundedness conditions and Fredholm criteria for pseudodifferential operators with certain symbols of limited smoothness on variable exponent Lebesgue spaces over \mathbb{R}^n . It is expected that obtained results can be further extended to more general Banach function spaces.

Ana Margarida Ribeiro in collaboration with E. Zappale, will carry on the study of minimizing problems for supremal functionals, now considering the vectorial case. Note that this type of problems includes the problem of Lipschitz extensions. The vectorial setting introduces new and challenging difficulties, and the starting point is a good understanding of the convexity conditions that play some role in this setting. This may also lead to a deeper knowledge on necessary and sufficient conditions for differential inclusions.

Bento Louro and Maria do Céu Soares are going to overcome technical difficulties encountered last year and expect to submit a paper with the full demonstration of the method of invariant embedding, applied to the Poisson problem in a quasi-cylindrical domain.

Fabio Chalub and M. Souza are finishing the paper "Fixation in Large Populations: A continuous view of a discrete problem" (its submission is planned in the first semester of 2014), where they study in detail the fixation probability for certain classes of evolutionary processes (generalized Moran processes) when the population is large. A series of expressions are found for three different cases: dominance, coordinations and coexistence (using the language of game theory). For the first two, the analysis in the finite population and infinite population cases do not differ too much; however, in the third case, this difference cannot be neglected. This follows from the fact that the coexistence case is an example of mixed population that can exist stably only if the population is infinite.

Fabio Chalub and O. Danilkina are going to prove existence of solutions in measure sense for certain classes of degenerated PDEs supplemented by conservation laws (and not by boundary conditions).

Fabio Chalub, Paulo Doutor, Paula Rodrigues and Maria do Céu Soares will work in the study of the effect of compulsory and voluntary vaccinations in the dynamics of seasonal

diseases. For seasonal diseases we consider two different definitions of vaccinations strategies: in the first case, the "government" point of view, we look for the minimum number of vaccinations necessary to prevent outbreaks; in the second cases, the "individual" point of view, we consider that an individual accepts to be vaccinated if and only if the risk of the vaccination is lower than the risk of the disease. These two different point of views induces different solutions of traditional SIR dynamics. We show that optimal vaccinations should be performed before the maximum transmission rate is achieved (even if there is no time lag between the vaccination and the immunization) and show that in the case of rational vaccinations people will run for the hospitals to take the vaccine only when it is too late to prevent the epidemic. For weakly seasonal diseases, the total number of vaccinations in the two cases will be the same, however the rational strategy will not prevent outbreaks.

José Maria Gomes has been studying geometrical aspects of the solutions of the elliptic equation $-\Delta u = f(u)$ using the method of inner variation. The submission of a paper in this field is expected during 2014.

Luísa Mascarenhas and Rita Ferreira, in collaboration with I. Fonseca, will continue to address the imaging processing problem aiming at denoising colored images using a " $u + v$ " model coupled with a chromaticity-brightness decomposition approach. As mentioned, it amounts to solve a minimization problem associated with functionals defined in the product of the space BV of functions of bounded variation with a Sobolev space with values in S^2 . These functionals are characterized by a lack of coercivity in one of its variables, leading us to an open and very interesting problem in applications. The mathematical analysis of this problem will be carried out within the scope of Calculus of Variations, Geometric Measure Theory and Nonlinear Partial Differential Equations. Another subject will consist in studying the asymptotic behavior of a 3D-1D waveguide with periodic heterogeneities along its length. Some interesting difficulties seem to appear.

Maria do Céu Soares plans the submission of a paper concerning the results obtained within the epigames' project.

Maria d'Orey and Bento Louro plan to submit a paper on the factorization of over-determined boundary value problems.

Paula Rodrigues plans to work on applications of optimal control theory to treatment and vaccination of infectious diseases, following her previous work with some colleagues from U. Aveiro. She is going to submit a manuscript on control measures for tuberculosis.

Rita Ferreira, Alexei Karlovich and Ana Margarida Ribeiro will work on problems involving variable exponent Sobolev spaces. Their first goal, coming in the sequel of an ongoing work of Carolin Kreisbeck, Rita Ferreira and Ana Margarida Ribeiro, is to obtain new characterizations of these spaces through conditions involving non-local integral functionals used in imaging models. This may also raise other relevant questions regarding variational problems in variable exponent Sobolev spaces with possible applications in imaging.

Rita Ferreira and D. Gomes will continue the work on the convergence of finite state mean-field games through Γ -convergence. They plan to address the continuous state case to the class of mean-fielded games studied in their previous paper submitted in 2013.

Rogério Martins will continue the study of the dissipative sine-Gordon equation and its relation with systems of coupled oscillators, more precisely the study of the attractors of this system.

6. 2. 3. Main Achievements

Highlights:

Fabio Chalub:

The start of the "Investigador FCT" grant, that allows the dedication to research up to 100% of the time.

Achievements by Integrated Members:

Alexei Karlovich in collaboration with Yu. Karlovich and A. Lebre proved that simplest singular integral operators with slowly oscillating shifts are Fredholm and their indices are equal to zero. The paper on this work was accepted for publication in Operators and Matrices.

Alexei Karlovich proved a boundedness result for pseudodifferential operators with symbols in the Hörmander and Miyachi classes on Banach function spaces (the latter class of spaces includes rearrangement-invariant spaces as well as variable Lebesgue spaces).

The paper on this work is accepted for publication in Operator Theory: Advances and Applications.

Ana Margarida Ribeiro in collaboration with E. Zappale, has finished the preparation of a paper dealing with existence of minimizers for supremal functionals in the lack of the appropriate convexity condition which ensures lower semi-continuity. The case treated is the one dimensional one and the analysis is made through the solutions for some related differential inclusion. The paper has been accepted for publication in SIAM Journal on Control and Optimization (SICON).

Bento Louro, Maria do Céu Soares and J. Henry solved some technical difficulties associated to a trace lifting associated with the method of invariant embedding, applied to the Poisson problem in a quasi-cylindrical domain.

Fabio Chalub and M. Souza worked in populational dynamics. Their paper "The frequency-dependent Wright-Fisher model: diffusive and non-diffusive approximations" was accepted in 2013 (published in 2014) by the Journal of Mathematical Biology and the paper "Discrete and continuous SIS epidemic models: A unifying approach" was accepted by Ecological Complexity. They started to work on the paper "Fixation in Large Populations: A continuous view of a discrete problem".

Fabio Chalub, Paulo Doutor, Paula Rodrigues and Maria do Céu Soares studied the effect of voluntary vaccinations in seasonal epidemics. To the best of their knowledge, both effects were never studied together. They used Game Theory to model the way people decide to vaccinate themselves and analysed the SIR model with seasonality. Their approach gives a new insight over the model.

Fabio Chalub in collaboration with R. Teixeira and A. Almeida worked on the paper "Much or More? Experiments of Rationality and Spite with School Children", which was accepted (and published in 2014) by the North American Journal of Psychology.

Luísa Mascarenhas in collaboration with C. Kreisbeck studied the asymptotic behavior of the spectrum of a one dimensional waveguide with non homogeneous periodically varying cross section. Homogenization and dimension reduction were performed. This was a first step towards the study of the macroscopic behavior of composite fibers, with

microscopic periodic texture or not. The obtained results were submitted for publication in November of 2013.

A pre-print of this paper is available at: <http://arxiv.org/abs/1309.3831>.

Maria d'Orey and Bento Louro worked on the factorization of over-determined boundary value problems.

Paula Rodrigues in collaboration with R. Andrade, G. Gomes, J. S. Lopes, S. Pinho and H. Serra studied the impact of the reduction of treatment length on tuberculosis incidence in the framework of the project "Sistemas complexos na dinâmica de infecção de tuberculose e dengue" (funded by the Bilateral Agreement Portugal-Brazil FCT/CAPES). This work was submitted for publication.

Paula Rodrigues collaborated with R. Andrade, R. Duarte, G. Gomes, J. S. Lopes, and S. Pinho on the interpretation of tuberculosis transmission measures based on the Portuguese population data, to be submitted soon. This work results from the project "Molecular epidemiology of Mycobacterium tuberculosis in Portugal: Implementing and analysing a database" (PTDC/SAU-ESA/71208/2006).

Rita Ferreira and Ana Margarida Ribeiro in collaboration with C. Kreisbeck, have been studying certain integral conditions involving the difference quotients of a measurable function. These conditions are related with certain non-local functionals used in image restoration. The goal of this study is, in one hand, to give a new characterization of k th-order Sobolev spaces and, on the other hand, to give sufficient conditions to a measurable function to be a polynomial. This work will be soon submitted for publication.

Rita Ferreira and D. Gomes studied the long time behavior of continuous time finite state (potential) mean-field games using Gamma-convergence. This is the first work where Gamma-convergence techniques are used within mean-field games. The method they proposed allows extending existent results in literature as it requires weaker hypotheses than the ones usually assumed. The paper on this work was submitted to the Journal of Mathematical Analysis and Applications.

Rita Ferreira and Luísa Mascarenhas, in collaboration with I. Fonseca, were addressing an imaging processing problem aiming at denoising colored images using a " $u + v$ " model coupled with a chromaticity-brightness decomposition approach. It amounts to solve a

minimization problem associated with functionals defined in the product of the space BV of functions of bounded variation with a Sobolev space with values in S^2 . These functionals are characterized by a lack of coercivity in one of its variables, leading us to an open and very interesting problem in applications. The mathematical analysis of this problem is carried out within the scope of Calculus of Variations, Geometric Measure Theory and Nonlinear Partial Differential Equations. Some technical difficulties were occurred and an article on the subject is still in preparation.

Rogério Martins studied the relativistic pendulum and its attractor.

6. 2. 4. Group Productivity

6. 2. 4. 1. Book Chapter

Karlovich, A. Yu. and Spitkovsky, I. M. (2013), *Pseudodifferential operators on variable Lebesgue spaces*, Operator theory, pseudo-differential equations, and mathematical physics, The Vladimir Rabinovich anniversary volume, Basel: Birkhäuser/Springer. Operator Theory: Advances and Applications, 228, 173-183.

URL: http://link.springer.com/chapter/10.1007%2F978-3-0348-0537-7_9

6. 2. 4. 2. Publications in Peer Review Journals

1. Barroso, A. C., Croce G. and **Ribeiro, A. M.** (2013), *Sufficient conditions for existence of solutions to vectorial differential inclusions and applications*, Houston Journal of Mathematics, 39 (3), 929-967 [Impact factor = 0.357].

URL: <http://www.math.uh.edu/~hjm/Vol39-3.html>

2. **Ribeiro, A. M.** and Zappale, E. (2013), *Relaxation of certain integral functionals depending on strain and chemical composition*, Chinese Annals of Mathematics, Series B, 34 (4), 491-514 [Impact factor = 0.504].

URL: <http://link.springer.com/article/10.1007%2Fs11401-013-0784-x>

6. 2. 4. 3. Papers Accepted in Peer Review Journals

1. Almeida, A., **Chalub, F. A. C. C.** and Teixeira R., *Much or More? Experiments of rationality and spite with school children*, to appear in North American Journal of Psychology, 16 (1), 163-178.

2. **Chalub, F. A. C. C.** and Souza, M. O. (2014), *The frequency-dependent Wright-Fisher model: diffusive and non-diffusive approximations*, Journal of Mathematical Biology, 68 (5), 1089-1133 [Impact factor = 2.366].

URL: <http://link.springer.com/article/10.1007%2Fs00285-013-0657-7>

3. **Guerra, T.**, Tiago, J. and Sequeira, A., *On the optimal control of a class of non-Newtonian fluids*, to appear in Journal Annali dell' Università di Ferrara.

4. **Karlovich, A. Yu.**, Karlovich, Yu. I. and Lebre A. B., *Fredholmness and index of simplest singular integral operators with two slowly oscillating shifts*, to appear in Operators and Matrices [Impact factor = 0.529].

6. 2. 4. 4. Papers Submitted to Peer Review Journals

1. **Chalub, F. A. C. C.** and Souza, M., *Discrete and continuous SIS epidemic models: A unifying approach*, submitted to Ecological Complexity (submitted in 2013, accepted in 2014, available online 16.03.2014) [Impact factor = 2.340].

URL: <http://dx.doi.org/10.1016/j.ecocom.2014.01.006>

2. **Ferreira, R.** and Gomes, D., *On the convergence of finite state mean-field games through Gamma-convergence*, submitted to Journal of Mathematical Analysis and Applications (submitted in 2013, accepted in 2014, available online 25.02.2014) [Impact factor = 1.050].

URL: <http://dx.doi.org/10.1016/j.jmaa.2014.02.044>

3. **Guerra, T.**, Tiago J. and Sequeira A., *Optimal control in blood flow simulations*.

4. Kreisbeck, C. and **Mascarenhas, L.**, *Asymptotic spectral analysis in semiconductor nanowire heterostructures*.

URL: <http://arxiv.org/abs/1309.3831>

5. **Ribeiro, A. M.** and Zappale, E., *Existence of minimizers for non-level convex supremal functionals*, submitted to SIAM Journal on Control and Optimization (submitted in 2013, accepted in 2014) [Impact factor = 1.379].

6. 2. 4. 5. Other International Publications

6. 2. 4. 5. 1. Conference Proceedings with Peer-Review

1. **Guerra, T.**, Tiago, J. and Sequeira, A. (2013), *Towards a data assimilation method for blood circulation*, Proceedings of the 13th International Conference of Computational and Mathematical Methods in Science and Engineering, CMMSE, Almeria, 808-812.

URL: <http://gsii.usal.es/~CMMSE/images/stories/congreso/volume3-cmmse-20013.pdf>

2. **Karlovich, A. Yu.**, *Boundedness of pseudodifferential operators on Banach function spaces*, to appear in Operator Theory, Operator Algebras and Applications. Basel: Birkhäuser/ Springer. Operator Theory: Advances and Applications, 242, 185-195.

3. **Ribeiro, A. M.** and Zappale, E., *Lower semicontinuous envelopes in $W^{1,1} \times L^p$* , to appear in Banach Center Publications, 101.

4. **Rodrigues P.**, Silva C. J. and Torres D. F. M. (2013), *Optimal control strategies for reducing the number of active infected individuals with tuberculosis*, Proceedings of the SIAM Conference on Control and Its Applications (CT13), San Diego, California, USA, 44-50, 8-10 July 2013.

URL: <http://dx.doi.org/10.1137/1.9781611973273.7>

6. 2. 4. 6. Organization of Conferences

Rita Ferreira and Ana Ribeiro: Organization of a Thematic Session - "PDE's and Calculus of Variations" of the conference "Dynamics, Games and Science 2013 - International Conference and Advanced School Planet Earth, Dynamics, Games and Science", 2 September 2013.

URL: <http://mpe.dimacs.rutgers.edu/workshop/dgs-2013-international-conference-and-advanced-school-planet-earth-dynamics-games-and-science-portugal-26-august-to-7-september-2013/>

6. 2. 4. 7. Patents

Maria do Céu Soares, Tetra4Math, no. 3893/2013 (IGAC).

6. 2. 4. 7. Others

Maria do Céu Soares, ClubeMath: a funny way of enjoying Maths, MiMa's kick-off meeting, University of Perugia, Perugia, 3 December de 2013.

6. 2. 5. Internationalization

6. 2. 5. 1. Publications

1. Barroso, A. C., **Croce, G. (France)** and Ribeiro, A. M. (2013), *Sufficient conditions for existence of solutions to vectorial differential inclusions and applications*, Houston Journal of Mathematics, 39 (3), 929-967 [Impact factor = 0.357].

URL: <http://www.math.uh.edu/~hjm/Vol39-3.html>

2. Chalub, F. A. C. C. and **Souza, M. (Brazil)**, *Discrete and continuous SIS epidemic models: A unifying approach*, Ecological Complexity (submitted in 2013, accepted in 2014, available online 16.03.2014) [Impact factor = 2.340].

URL: <http://dx.doi.org/10.1016/j.ecocom.2014.01.006>

3. Chalub F. A. C. C. and **Souza M. (Brazil)** (2014), *The frequency-dependent Wright-Fisher model: diffusive and non-diffusive approximations*, Journal of Mathematical Biology, 68 (5), 1089-1133 [Impact factor = 2.366].

URL: <http://link.springer.com/article/10.1007%2Fs00285-013-0657-7>

4. Karlovich, A. Yu., **Karlovich, Yu. I. (Mexico)** and Lebre, A. B., *Fredholmness and index of simplest singular integral operators with two slowly oscillating shifts*, to appear in Operators and Matrices [Impact factor = 0.529].

5. Karlovich, A. Yu. and **Spitkovsky I. M. (USA)** (2013), *Pseudodifferential operators on variable Lebesgue spaces*, in: Operator theory, pseudo-differential equations, and mathematical physics. The Vladimir Rabinovich anniversary volume. Basel: Birkhäuser/Springer. Operator Theory: Advances and Applications 228, 173-183.

URL: http://link.springer.com/chapter/10.1007%2F978-3-0348-0537-7_9

6. **Kreisbeck, C. (Germany)** and Mascarenhas, L., *Asymptotic spectral analysis in semiconductor nanowire heterostructures* (submitted in 2013).

URL: <http://arxiv.org/abs/1309.3831>

7. Ribeiro, A. M. and **Zappale, E. (Italy)**, *Existence of minimizers for non-level convex supremal functionals*, submitted to SIAM Journal on Control and Optimization (submitted in 2013, accepted in 2014) [Impact factor = 1.379].

8. Ribeiro, A. M. and **Zappale, E. (Italy)**, *Lower semicontinuous envelopes in $W^{1,1}_p \times L^p$* , to appear in Banach Center Publications, 101.

9. Ribeiro, A. M. and **Zappale, E. (Italy)** (2013), *Relaxation of certain integral functionals depending on strain and chemical composition*, Chinese Annals of Mathematics, Series B, 34 (4), 491-514 [Impact factor = 0.504].

URL: <http://link.springer.com/article/10.1007%2Fs11401-013-0784-x>

(i) Invited talks at international conferences

1. **Chalub, F. A. C. C.**, *The Generalized Kimura Equation*, Biological invasions and evolutionary biology, stochastic and deterministic models, Lyon, France, 11-15 March 2013 (invited speaker).

2. **Ferreira, R.**, *Finite state (potential) mean-field games: long time behavior via Gamma-convergence*, Dynamics, Games and Science 2013 - International Conference and Advanced School Planet Earth, Dynamics, Games and Science (Thematic Session: Optimal Control and Calculus of Variations), September 2013.

3. **Mascarenhas, L.**, Third Workshop on Thin Structures, Naples, Italy, 5-7 September 2013.

4. **Ribeiro, A. M.**, *Sufficient conditions for existence of solutions to vectorial differential inclusions*, International Workshop Multi-Scale Modeling and Characterization of Innovative Materials and Structures, Cetara, Italy, May 2013.

(ii) Contributed talks at international conferences

Chalub, F. A. C. C., *The Generalized Kimura Equation*, MPDE-13 Models in Population Dynamics and Ecology, Osnabrueck University, Germany, August 2013.

(iii) Seminar talks

1. **Karlovich, A. Yu.**, *Pseudodifferential operators on Banach function spaces*, Seminar

– "Grupo de Análise Funcional e Aplicações do Centro I&D em Matemática e Aplicações", Universidade de Aveiro, Portugal, 14 March 2013.

2. **Ribeiro, A. M.**, *Existence of solutions for non level-convex problems in the supremal form*, Oberseminar Analysis, Universität Regensburg, Regensburg, Germany, 8 February 2013.

3. **Ribeiro, A. M.**, *Existence of solutions for non level-convex problems in the supremal form*, Maths Department Seminar, Politecnico di Milano, Milan, Italy, 7 June 2013.

(iv) Short Term Visits

1. **Chalub, F. A. C. C.**, A Course in Population Dynamics, Institute for Pure and Applied Mathematics (IMPA, Rio de Janeiro, Brazil), January-February 2013.

2. **Mascarenhas, L.**, IMATH, Université du Sud-Toulon et Var, France, 20-27 January 2013.

3. **Mascarenhas, L.**, Center for Nonlinear Analysis, Carnegie Mellon University, USA, 20 April-4 May 2013.

4. **Mascarenhas, L.**, Università di Salerno, Italy, 9-11 September 2013.

(v) Long Term Collaborations

Alexei Karlovich:

- Ilya Spitkovsky (College of William and Mary, VA, USA);
- Yuri Karlovich (Universidad Autónoma del Estado de Morelos, Mexico).

Ana Margarida Ribeiro:

- Carolin Kreisbeck, former post-doc at UNL (Universität Regensburg, Germany);
- Elvira Zappale (Università di Salerno, Italy).

Fabio Chalub:

- Max Souza (Universidade Federal Fluminense, Brazil);
- Olga Danilkina, former post-doc at UNL (University of Dodoma, Tanzania).

Luísa Mascarenhas:

- Andrei Pyatniktski (Narvik University College, Norway);
- Carolin Kreisbeck, former post-doc at UNL (Universität Regensburg, Germany);
- Guy Bouchitte (Université du Sud - Toulon - Var, France);
- Irene Fonseca (Center for Nonlinear Analysis, Carnegie Mellon University, USA).

Maria d'Orey, Bento Louro and Maria do Céu Soares:

- Jacques Henry (INRIA Bordeaux Sud-Ouest, ANUBIS team).

Rogério Martins:

- Alexander Gutiérrez (Universidad Tecnológica de Pereira, Colombia);
- Pedro Torres (Universidad Granada, Spain);
- Rafael Ortega (Universidad Granada, Spain).

6. 2. 6. Other Important Information

(i) Activities

Integrative/multidisciplinary

Fabio Chalub ongoing collaboration with chemists and biologists.

Outreach activities

Fabio Chalub has a regular column at Gazeta de Matemática (3 times a year) where he explains for college students and high school teachers a recent paper where mathematics plays a relevant role.

Paulo Doutor participated in the sessions of the Aleph school, a math school for students from 7-9th grade <http://aleph.ptmat.fc.ul.pt>

Paulo Doutor and Paula Rodrigues are member of divMAT, a team of the Department of Mathematics of FCT-UNL, that has the purpose to divulgate the activities (courses, research, etc) of the Department of Mathematics. In particular, this team organized the activities of the Department of Mathematics in the ExpoFCT.

Rogério Martins delivered several talks on popularization of mathematics:

- *Elogio da diferença*, TEDxIST, 23 February 2013;

- *Sincronização do ponto de vista da matemática*, MatOeste, Leiria, 22 July 2013;
- *Sincronização*, Encontro da Associação Juvenil de Ciência, 6 September 2013;
- *Profissão Matemático*, MatNova2013, 8 September 2013;
- *Sincronização do ponto de vista da matemática*, Instituto Politécnico Setúbal, 14 November 2013;
- *Porque me apaixonei por matemática*, TEDx Youth, Leiria, 16 November 2013;
- *Sincronização*, Casa Pia de Lisboa, Centro de Educação e Desenvolvimento Jacob Rodrigues Pereira, 5 December 2013.

Maria do Céu Soares:

- Co-organizer of MATER, a scientific exposition integrated in the international celebrations of 2013 as the year of Mathematics of Planet Earth. This exhibition includes five modules, namely Time, Space, Art, Life and Quotidian (<http://eventos.fct.unl.pt/mater2013>);
- Co-organizer of ClubeMath, a Club for basic and high school students, which aims to show a different side of Mathematics, through fun and recreational activities, in order to stimulate skills and interest in this science (<http://eventos.fct.unl.pt/clubemath>).

(ii) Peer-reviewing activities

Alexei Karlovich:

- Referee for Complex Variables and Elliptic Equations;
- Referee for Journal of Convex Analysis;
- Referee for the special volume Operator Theory, Operator Algebras and Applications in the series Operator Theory: Advances and Applications.

Ana Margarida Ribeiro:

- Referee for SIAM Journal on Mathematical Analysis (SIMA).

Fabio Chalub:

- Referee for Journal of Mathematical Biology, Ecological Complexity.

José Maria Gomes:

- Referee for Boundary Value Problems.

Luísa Mascarenhas has participated in

- Evaluation of FCT projects;
- Ph.D. jury in 2 theses at Universidade de Lisboa (Sérgio Lopes and Rafayel Teymurazyán);
- Jury of professor positions at Universidade de Trás-os-Montes and at Universidade Aberta;
- Referee for Applicable Analysis.

Paula Rodrigues:

- Referee for Theoretical Population Biology.

Rita Ferreira:

- Referee for SIAM Journal on Mathematical Analysis (SIMA).

(iii) Supervisions of Ph.D. (2013)

Fabio Chalub: co-supervisor of André Almeida (Anthropology Department, FCSH/UNL).

Rogério Martins: supervisor of Gonçalo Nuno Rosado Morais (Department of Mathematics, FCT/UNL).

6. 3. Operations Research Team

Integrated Members

- Ana Luísa da Graça Batista Custódio
- Isabel Cristina Silva Correia
- Manuel Valdemar Cabral Vieira
- Maria do Carmo Proença Caseiro Brás
- Maria Isabel Azevedo Rodrigues Gomes
- Nelson Fernando Chibeles Pereira Martins
- Paula Alexandra da Costa Amaral
- Susana Maria Marques Henriques Botelho Baptista

Collaborators Members

- Ana Paula Ferreira Dias Barbosa da Póvoa
- Bruna Alexandra Elias Mota (Ph.D. student)
- Maria Paula da Costa Couto
- Rui Alberto Pimenta Rodrigues

6. 3. 1. Funding, Source, Dates

Projects led by other institutions, with participation of team OR members, eventually with no budget in our institution:

	Project Title	Principal Investigator	Team Members	Period	Total Funding
1. PTDC/MAT/098214/2008	"Derivative-free optimization: future challenges and new applications"	Luís Nunes Vicente	Ana Luísa Custódio	2010-2013	158.256 € (UC)
2. PTDC/SEN-ENR/102869/2008	"PEERChain-design and planning of energy efficient and resilient supply chains"	Ana Paula Póvoa	Maria Isabel Gomes, Nelson Martins and Susana Baptista	2010-2013	199.991 € (IST)
3. PTDC/MAT/116736/2010	"Sparse and Smoothing Methods for Nonlinear Optimization of Complex Models"	Luís Nunes Vicente	Ana Luísa Custódio	2012-2014	78 500 € (UC)

4. 539872-LLP-1-2013-1-IT-COMENIUS-CMP	"MiMa-Mathematics in the Making"	Emmanuela Ughi (Università degli Studi di Perugia - Italy)	Susana Baptista, Nelson Chibeles-Martins, Gracinda Guerreiro(*) and Maria do Céu Soares(**)	2013-2014	369.851 €
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(*) – Member of the SRM team participating in this project.

(**) – Member of the DENA team participating in this project.

6.3.2. Objectives

For the year 2014 the members of the team will continue the development of research in the Combinatorial Optimization and Non-Linear Optimization areas focusing on the following main problems:

- constrained fractional quadratic problems;
- matrix copositivity certificates;
- facility location and facility layout problems;
- derivative free optimization problems with inviolable constraints;
- derivative free global multi-objective optimization;
- models and heuristics for the design and planning of supply chains.

Additionally to the research activities the following initiatives will be undertaken:

- In May 2014 the Mathematics Department will host the 101th European Study Group with Industry. Three members of the team (Paula Amaral, Nelson Chibeles-Martins and Rui Rodrigues) are part of the local organizing committee. Additionally, the meeting will have the participation of other group members. As an output, we expect that new collaborations with industrial partners could be established.
- One member of the team (Ana Luísa Custódio) and another CMA member founded the first SIAM Student Chapter in Portugal. A team of FCT-UNL students, from several courses and graduation levels, are working together in this project since the beginning of 2014. With this initiative we expect to attract students with different backgrounds to the Operations Research area.
- The group seminars continue in 2014. This year the organizer is Carmo Proença Brás.
- Two members of the team (Susana Baptista and Nelson Chibeles-Martins) continue as co-organizers of ClubeMath which is a Mathematics Club with recreational activities for pre-university students.

Integrated Members:

Ana Luísa Custódio's research will be focused in derivative-free optimization problems with inviolable constraints. This class of problems appears in several areas of engineering optimization, sometimes associated to numerical noise. When a constraint is classified as inviolable, the simple test of an infeasible point will cause the crash of the simulation which is used to evaluate the problem functions. The analytical expressions corresponding to the inviolable constraints are unknown, being Lipschitz continuity the only knowledge available about these functions (evidently without the knowledge of the corresponding constant). She intends to address the deterministic case, and evolve to situations where function evaluation is contaminated by numerical noise.

In 2013 GLODS algorithm, a global optimization direct search method proposed for univariate optimization, exhibited promising numerical results when compared with state-of-art solvers suited for Derivative-free Global Optimization. She intends to generalize this method to Global Multiobjective Derivative-free Optimization.

Some work will also be developed, jointly with researchers from Civil Engineering, in practical applications for the determination of steel fiber reinforced concrete tensile behavior.

Carmo Proença Brás aims to design an efficient global optimization algorithm to detect copositivity, since the problem of determining whether a matrix is or not copositive is NP-complete.

Isabel Correia is working in location problems. More specifically, her objectives include the writing of a review paper on discrete facility location problems under uncertainty and the study of a variant of the classical multi-period facility location problem.

Maria Isabel Gomes is going to develop a generic multi-objective MILP model for the design and planning of supply chains, integrating the three dimensions of sustainability: economic (total supply chain cost), environmental (through different environmental assessment methodologies), a social indicator (which model social and political concerns on company's performance). A set of strategies to select the best solution among the obtained optimal ones will be applied.

Maria Isabel Gomes in collaboration with Susana Baptista are going to address the design and operations planning of a multi-period, multi-product closed loop supply chain, where the original equipment manufacturer operates the forward and reverse supply chain.

Several problem parameters, such as transportation costs, product demands, returned product volumes and returned product evaluations, are considered to be stochastic. Further, different topology decisions are to be defined at different stages of the time horizon so that topological decisions are dynamic. From a modeling perspective, a two-stage stochastic programming model is to be proposed, modeling the classical risk neutral and an extension to a risk adverse attitude.

Manuel Valdemar Cabral Vieira is going to develop a mathematical optimization framework to the Facility Layout Problem. This framework is composed by two mathematical optimization models, where the first model gives an approximation layout (in general, not feasible) and the second mathematical optimization model, using the solution of the first model, returns a final layout. It is expected to improve solutions of previously published works for large instances.

Nelson Chibeles-Martins is going to present the paper "Multi-Objective Meta-Heuristic Approach of a Flexible Supply Chain Network Design and Planning" in an international conference. Another of his goals is to generalize the methodology used in the previous paper to the design and scheduling of multi-product multipurpose plants.

Paula Amaral continues the study of constrained fractional quadratic problems in order to develop a global optimization procedure that can compete with existing methods. The lower bounds obtained from previous work on copositive relaxations will be integrated in a branch-and-bound approach. She also plans to continue the work initiated with Eduardo Amaldi on clusters of feasible sub-problem in a primal infeasible LP.

Susana Baptista will focus on solution methods for problems generally formulated by the model presented earlier by Baptista et al (2014) for a decision maker with a risk neutral attitude. Due to the large dimensions of the problem instances, the analysed solution methods will be heuristic methods *versus* exact methods based on decomposition, such as scenario decomposition.

Collaborators:

Paula Couto is going to do a review of methods used in human identification based on ECG (electrocardiograms) and try to perform improvements using neural networks. She will still continue the work related to ECG denoising.

6. 3. 3. Main Achievements

Highlights:

The paper *Addressing the uncertain quality and quantity of returns in closed-loop supply chains* by L. J. Zeballos, M. I. Gomes, A. P. Barbosa-Póvoa, and A. Q. Novais received the award for the Most Downloaded Articles from September 2012 to August 2013 by the journal Computers & Chemical Engineering. This work reached position 37 among the 138 papers of Computers & Chemical Engineering with more than 500 downloads.

Rui Rodrigues was ranked 3rd in the PhysioNet/Computing in Cardiology Challenge 2013.

Achievements by Team and by Integrated Members:

- During 2013 the OR team has published four papers in peer-reviewed international journals and six papers were accepted for publication. Three book chapters have also been accepted for publication and five conference proceedings were published.
- Seven members of the team were the local organizers of the conference ICCOPT 2013 which gathered about 500 participants.
- Two members of the team are authors or co-authors of three awarded works.
- The team members had also an important activity in peer-review of top-ranking journals.
- The majority of the members have international collaborations.
- Some of the specific main scientific achievements of the team members are listed below:

Ana Luísa Custódio has finished the convergence analysis and numerical testing of GLODS (Global and Local Optimization by Direct Search) algorithm. A numerical Matlab implementation was released, jointly with a problem collection suited for Global Optimization. A scientific disclosure work regarding Derivative-free Optimization applications in Astrophysics was also prepared.

Carmo Proença Brás studied the second-order cone eigenvalue complementarity problem as a global optimization problem. An algorithm for the symmetric case was designed.

Isabel Correia studied the impact of fixed and variable costs in a project scheduling problem with flexible resources. A modeling framework for project staffing and scheduling problems was also developed and this work is going to appear in the "Handbook on Project Management and Scheduling", to be published by Springer.

Manuel Valdemar Cabral Vieira studied new connections between SAT and certificates of infeasibility given by SDP models which allowed extracting partial information from the certificate about the SAT instance.

Maria Isabel Gomes studied the multi-depot vehicle routing problem with mixed closed and open routes. A MILP formulation with capacity and time duration constraints was developed. A special routing feature that characterizes the cooking oil bins collection was addressed. The model was applied to a real waste oil collection system, planning its collection routes. She has also addressed the topic of sustainability within vehicle routing problems by developing a multi-objective model which account for economical, environmental and social objectives. Decisions on service areas definition, routing and scheduling were also tackled. A real recyclable waste collection system case was solved. Finally an Ant Colony Optimization approach was applied to the design and planning of supply chains with reverse flows. Some nonlinear dimensioning factors were addressed. A comparative analysis was made between a MILP model and the ant colony approach.

Nelson Chibeles-Martins performed the computational experience on a multi-objective meta-heuristic for the design and planning of a flexible supply chain network. The resulting work was accepted for publication on the proceedings of conference ESCAPE 24.

Paula Amaral finished the work initiated in 2010 on copositive formulations for the constrained fractional quadratic problem with the empirical proof of the high quality of SDP relaxations.

Susana Baptista developed a stochastic model for a multi-period multi-product closed loop supply chain. This work was published in the proceedings of the Portuguese Association of Operations Research conference.

6. 3. 4. Group Productivity

6. 3. 4. 1. Book Chapter

1. **Correia, I.** and Saldanha da Gama, F., *A Modeling Framework for Project Staffing and Scheduling Problems*, to appear in Handbook on Project Management and Scheduling, Christoph Schwindt and Jürgen Zimmermann (eds). Springer.

2. **Gomes, M. I.** and Barbosa-Póvoa, A. P., *Projeto de uma rede logística para a recolha de equipamentos elétricos e eletrónicos*, to appear in *Investigação Operacional em Ação – Casos de Aplicação*, R. Oliveira and J. Soeiro Ferreira (ed.).

3. Ramos, T., **Gomes, M. I.** and Barbosa-Póvoa, A. P., *Reestruturação de Áreas de Influência e de Rotas de Veículos num Sistema de Recolha de Resíduos Recicláveis*, to appear in *Investigação Operacional em Ação – Casos de Aplicação*, R. Oliveira and J. Soeiro Ferreira (ed.).

6. 3. 4. 2. Publications in Peer Review Journals

1. Anjos, M. F. and **Vieira, M. V. C.** (2013), *Semidefinite Resolution and Exactness of Semidefinite Relaxations for Satisfiability*, *Discrete Applied Mathematics*, 161 (18), 2812-2826 [Impact factor = 0.718].

URL: <http://www.sciencedirect.com/science/article/pii/S0166218X13002990>

2. **Correia, I.**, Melo, T. and Saldanha da Gama, F. (2013), *Comparing classical performance measures for a multi-period, two-echelon supply chain network design problem with sizing decisions*, *Computers & Industrial Engineering*, 64 (1), 366-380 [Impact factor = 1.516].

URL: <http://www.sciencedirect.com/science/article/pii/S0360835212002781>

3. Ramos, T. P. R., **Gomes, M. I.** and Barbosa-Póvoa, A. P. (2013), *Planning Waste Cooking Oil Collection Systems*, *Waste Management*, 33 (8), 1691-1703 [Impact factor = 2.485].

URL: <http://www.sciencedirect.com/science/article/pii/S0956053X13001748>

4. **Vieira, M. V. C.** (2013), *Interior-point methods for symmetric optimization based on a class of non-coercive kernel functions*, *Optimization Methods and Software*, 28 (3), 581-599 [Impact factor = 0.683].

URL: <http://www.tandfonline.com/doi/abs/10.1080/10556788.2011.651083>

6. 3. 4. 3. Papers Accepted in Peer Review Journals

1. **Amaral, P.**, Bomze, I. M. and Júdice, J. J., *Copositivity and constrained fractional quadratic problems*, to appear in *Mathematical Programming* [Impact factor = 2.090].

URL: <http://link.springer.com/article/10.1007%2Fs10107-013-0690-8>

2. **Brás, C.**, Júdice, J. J. and Sherali, H., *On the Solution of the Inverse Eigenvalue Complementarity Problem*, to appear in Journal of Optimization Theory and Applications [Impact factor = 1.423].

URL: <http://link.springer.com/article/10.1007/s10957-013-0464-8>

3. **Correia, I.**, Nickel, S. and Saldanha da Gama, F. (2014), *Multi-product capacitated single-allocation hub location problems: formulations and inequalities*, Networks & Spatial Economics, 14 (1), 1-25 [Impact factor = 1.226].

URL: <http://link.springer.com/article/10.1007/s11067-013-9197-3#page-1>

4. Ramos, T. P. R., **Gomes, M. I.** and Barbosa-Póvoa, A. P., *Assessing and improving management practices when planning packaging waste collection systems*, to appear in Resources Conservation and Recycling [Impact factor = 2.319].

URL: <http://www.sciencedirect.com/science/article/pii/S0921344913002796>

5. Ramos, T. P. R., **Gomes, M. I.** and Barbosa-Póvoa, A. P., *Economic and environmental concerns in planning recyclable waste collection systems*, to appear in Transportation Research Part E-Logistics and Transportation Review [Impact factor = 2.272].

URL: <http://www.sciencedirect.com/science/article/pii/S1366554513001968>

6. Ramos, T. P. R., **Gomes, M. I.** and Barbosa-Póvoa, A. P. (2014), *Planning a sustainable reverse logistics system: balancing costs with environmental and social concerns*, OMEGA, 48, 60-74 [Impact factor = 3.024].

URL: <http://www.sciencedirect.com/science/article/pii/S0305048313001175>

6.3.4.4. Papers Submitted

1. **Custódio, A. L.** and Madeira J. F. A., *GLODS: Global and Local Optimization using Direct Search*, Pre-print CMA-14-2013, Universidade Nova de Lisboa, Portugal.

2. Ramos, T. P. R., **Gomes, M. I.** and Barbosa-Póvoa, A. P., *Revisiting the Multi-Depot Vehicle Routing Problem with Inter-Depot Routes*.

3. Vieira, P. F., Vieira, S. M., Sousa, J. M. C., **Gomes, M. I.** and A. P. Barbosa-Póvoa, *Designing Closed-Loop Supply Chains with Nonlinear Dimensioning Factors Using Ant Colony Optimization*.

6. 3. 4. 5. Other International Publications

6. 3. 4. 5. 1. Conference Proceedings with Peer-Review

1. **Baptista, S., Gomes, M. I.** and Barbosa-Póvoa, A. P. (2013), *A stochastic model for a multi-period multi-product closed loop supply chain*, XVI Congresso da Associação Portuguesa de Investigação Operacional IO 2013, 27-37, Bragança, Portugal, June 2013.
URL: <https://bibliotecadigital.ipb.pt/handle/10198/8451>

2. Costa, P., **Gomes, M. I.**, Carvalho, A. and Barbosa-Póvoa, A. P. , *Decision Support Tool for Strategic Planning in Closed-Loop Supply Chains*, to appear in Conference European Symposium on Computer Aided Process Engineering - ESCAPE 24.

3. Mota, B., **Gomes, M. I.** and Barbosa-Póvoa, A. P. (2013), *Towards supply chain sustainability: balancing costs with environmental and social impacts*, in Computer Aided Process Engineering, edited by A. Kraslawski and I. Turunen, Elsevier, 32, 895-900.

URL: <http://www.sciencedirect.com/science/article/pii/B9780444632340501500>

4. Ramos, T., **Gomes, M. I.** and Barbosa-Póvoa, A. P. (2013), *Recyclable packaging waste collection systems: redesigning service areas and collection routes in a real case-study*, 2nd International Conference WASTES: Solutions, Treatments and Opportunities, Braga, Portugal.

5. Ramos, T., **Gomes, M. I.** and Barbosa-Póvoa, A. P. (2013), *Tactical and Operational Planning in Reverse Logistics Systems with Multiple Depots*, XVI Congresso da Associação Portuguesa de Investigação Operacional IO 2013, 286-295, Bragança, Portugal, June 2013.

URL: <https://bibliotecadigital.ipb.pt/handle/10198/8451>

6. **Rodrigues, R.** (2013), *Fetal ECG Detection in Abdominal Recordings: a Method for QRS Location*, Computing in Cardiology Conference (CinC), 325-328, 22-25 September.

6. 3. 4. 5. 2. Papers Submitted to Conference Proceedings with Peer Review

Mota, B., **Gomes, M. I.** and Barbosa-Póvoa, A. P., *Supply Chain Design towards sustainability: accounting for growth and jobs*, submitted to Conference FOCAPD 2014.

6. 3. 4. 6. Models (New materials, devices, products and processes)

A. L. Custódio and J. F. A. Madeira, A test set for global optimization (MATLAB) (available in November 2013).

6. 3. 4. 7. Computer code

A. L. Custódio and J. F. A. Madeira, GLODS: Global and Local Optimization using Direct Search (MATLAB), Version 0.1 (available in November 2013).

URL: <http://ferrari.dmat.fct.unl.pt/personal/alcustodio/glods>

6. 3. 4. 8. Patents

Mathdetetives – developed under ClubeMath activities.

6. 3. 4. 9. Organization of Conferences

1. Short Course on Multistage Stochastic Mixed Integer Optimization: Theory, Algorithms and Applications, by Laureano Escudero, FCT-UNL, 3 April 2013. Organized by Susana Baptista and Maria Isabel Gomes.

2. IO2013 – 16th Meeting of the Portuguese Association of Operations Research, Polytechnic Institute of Bragança, 3-5 June 2013. Maria Isabel Gomes was member of the scientific committee.

3. Summer School in PDE Constrained Optimization and Sparse Optimization and Applications to Information Processing, Faculty of Science and Technology, New University of Lisbon, 27-28 July 2013.

Organized by Ana Luísa Custódio.

4. 4th International Conference on Continuous Optimization - ICCOPT, Faculty of Science and Technology, New University of Lisbon, 27 July to 1 August 2013.

Paula Amaral (co-chair), Carmo Proença Brás, Nelson Chibeles-Martins, Isabel Correia, Ana Luísa Custódio, Maria Isabel Gomes and Manuel Valdemar Cabral Vieira were the members of the Local Organizing Committee.

6. 3. 5. Internationalization

Below, some information is provided about several international ongoing collaborations

where team members are enrolled:

Carmo Proença Brás has collaborative research with Hanif D. Sherali from the Grado Department of Industrial & Systems Engineering, Virginia Tech, USA.

Isabel Correia collaborates with Stefan Nickel, from the Institute of Operations Research, Karlsruhe Institute of Technology (KIT), Germany and with Maria Teresa Melo from the Business School, Saarland University of Applied Sciences, Germany.

Manuel Valdemar Cabral Vieira develops research with Miguel F. Anjos from the École Polytechnique de Montreal, Canada. M. V. C. Vieira is also an associate member of GERAD (Group for Research in Decision Analysis, Montreal, Canada).

Paula Amaral collaborates with Immanuel Bomze from the University of Vienna, Austria and with Eligius Hendrix from the University of Málaga, Spain.

Susana Baptista and Maria Isabel Gomes have collaborative research with Laureano Escudero and Celeste Pizarro from University Rey Juan Carlos, Spain. This research group also includes A. Barbosa-Póvoa from University of Lisbon.

(i) Invited talks at international conferences

1. **Amaral, P.**, Bomze, I. and Júdice, J., *Copositivity and constrained fractional quadratic problems*, Euro-Informs, 26th European Conference on Operational Research, Rome, Italy, July 2013.

2. **Chibeles-Martins, N.**, Pinto-Varela, T., Barbosa-Póvoa, A. P. and Novais, A. Q., *Greener Profits with Supply Chains - A Meta-heuristic approach for the Bi-Objective Design and Planning of Supply Chains*, MECC 2013 - International Conference and Advanced School Planet Earth, Mathematics of Energy and Climate Change, Lisboa, Portugal, March 2013.

URL: <http://sqig.math.ist.utl.pt/cim/mpe2013/docs/bookMECC2013.pdf>

3. **Correia, I.** and Saldanha-da-Gama, F., *A Cost Minimization Multi-skilled Resource Constrained Project Scheduling Problem*, Euro-Informs, 26th European Conference on Operational Research, Rome, Italy, July 2013.

4. **Custódio, A. L.** and Madeira, J. F. A., *GLODS: Global and Local Optimization using Direct Search*, 4th Mathematical Optimization Society International Conference on Continuous Optimization, Caparica, Portugal, July 2013.

URL: <http://www.norg.uminho.pt/iccopt2013-SP-contents/files/iccopt2013book.pdf>

5. **Gomes, M. I.**, Mota, B. and Barbosa-Póvoa, A. P., *Sustainability in the supply chain*, Euro-Informs, 26th European Conference on Operational Research, Rome, Italy, July 2013.

6. Mota, B., **Gomes, M. I.** and Barbosa-Póvoa, A. P., *A step towards supply chain sustainability*, MECC 2013 - International Conference and Advanced School Planet Earth, Mathematics of Energy and Climate Change, Lisboa, Portugal, March 2013.

URL: <http://sqig.math.ist.utl.pt/cim/mpe2013/docs/bookMECC2013.pdf>

7. **Vieira, M. V. C.**, *Extracting information of unsatisfiable formulas using Semidefinite certificates of infeasibility*, CanaDAM2013, Memorial University Newfoundland, Newfoundland, Canada, June 2013.

URL: <http://canadam.math.ca/2013f/abs/cgl>

(ii) Contributed talks at international conferences

1. **Brás, C. P.**, Júdice, J. J. and Serali, H. D., *Inverse Eigenvalue Complementarity Problem*, 4th Mathematical Optimization Society International Conference on Continuous Optimization, Caparica, Portugal, July 2013.

URL: <http://www.norg.uminho.pt/iccopt2013-SP-contents/files/iccopt2013book.pdf>

2. **Custódio, A. L.**, Madeira, J. F. A., Vaz, A. I. F. and Vicente, L. N., *Direct-multisearch: A robust and efficient alternative for Multiobjective Derivative-free Optimization*, Workshop SIMCO: Set-Oriented and Indicator-Based Multi-Criteria Optimization, Leiden, Netherlands, September 2013.

3. Mota, B., **Gomes, M. I.** and Barbosa-Póvoa, A. P., *Towards supply chain sustainability: balancing costs with environmental and social impacts*, Escape 23, Finland, June 2013.

4. Ramos, T., **Gomes, M. I.** and Barbosa-Póvoa, A. P., *A Multi-Depot Vehicle Routing Problem with Open Routes in a Waste Oil Collection System*, Mathematics of Operations and Logistics Conference, Zaragoza, Spain, June 2013.
5. Ramos, T., **Gomes, M. I.** and Barbosa-Póvoa, A. P., *Recyclable packaging waste collection systems: redesigning service areas and collection routes in a real case-study*, in 2nd International Conference WASTES: Solutions, Treatments and Opportunities, Braga, Portugal. September 2013.
6. **Rodrigues, R.**, *Fetal ECG in Abdominal Recordings: a Method for ECG Location*, Computing in Cardiology, Zaragoza, Spain, September 2013.

(iii) Contributed talks at national conferences

1. **Baptista, S.**, Gomes, M. I. and Barbosa-Póvoa, A. P., *Um modelo estocástico para cadeias de abastecimento multi-produto e multi-período com fluxos de retorno*, 16th National Meeting of the Portuguese Operations Research Society, Bragança, Portugal, June 2013.
2. **Brás, C. P.**, Júdice, J. J. and Serali, H. D., *Problema Inverso de Complementaridade e Valores Próprios: Aplicações e Resolução Numérica*, 16th National Meeting of the Portuguese Operations Research Society, Bragança, Portugal, June 2013.
URL: <https://bibliotecadigital.ipb.pt/handle/10198/8452>
3. **Chibeles-Martins, N.**, *Heurísticas para formação de turmas e grupos com várias restrições na composição*, 16th National Meeting of the Portuguese Operations Research Society, Bragança, Portugal, June 2013.
URL: <https://bibliotecadigital.ipb.pt/handle/10198/8452>
4. **Custódio, A. L.** and Madeira, J. F. A., *GLODS: Global and Local Optimization using Direct Search*, 16th National Meeting of the Portuguese Operations Research Society, Bragança, Portugal, June 2013.
URL: <https://bibliotecadigital.ipb.pt/handle/10198/8452>
5. Ramos, T., **Gomes, M. I.** and Barbosa-Póvoa, A. P., *Tactical and Operational Planning in Reverse Logistics Systems with Multiple Depots*, 16th National Meeting of the Portuguese Operations Research Society, Bragança, Portugal, June 2013.

URL: <https://bibliotecadigital.ipb.pt/handle/10198/8451>

6. Silva, M., Carvalho, F., Silva, P., Saldanha-da-Gama, F. and **Correia, I.**, *Reposição de numerário em ATM*, 16th National Meeting of the Portuguese Operations Research Society, Bragança, Portugal, June 2013.

URL: <https://bibliotecadigital.ipb.pt/handle/10198/8452>

(iv) Posters

1. **Custódio, A. L.**, *Calculando a idade das estrelas... um problema de OPTIMIZAÇÃO*, in exposição MATER, Faculty of Science and Technology, New University of Lisbon, Caparica, Portugal.

2. **Gomes, M. I.**, *Projecto e planeamento de cadeias de abastecimento com fluxos inversos: um modelo genérico*, in exposição MATER, Faculty of Science and Technology, New University of Lisbon, Caparica, Portugal.

6. 3. 6. Other Important Information

(i) Activities

Integrative/multidisciplinary

Ana Luísa Custódio is Advisor of the SIAM Student Chapter at UNL, the first SIAM Student Chapter in Portugal.

Outreach activities

Ana Luísa Custódio:

- Member of the organizing committee of the "3rd Journey of Mathematics of FCT-UNL", FCT-UNL, 8 March 2013;
- "Calculando a idade das estrelas: um problema de Optimização", poster in MATER Exhibition, in the scope of Mathematics of Planet Earth 2013, FCT-UNL, October to December 2013;
- "APDIO - Associação Portuguesa de Investigação Operacional", professional disclosure seminar in 3rd Journey of Mathematics of FCT-UNL, Portugal, March 2013;
- Collaborator of ClubeMath, Mathematics Club of FCT-UNL for high school students;
- Collaborator of EXPO2013, open day of FCT-UNL for high school students;

- Member of the Executive Board of the Portuguese Association of Operations Research (APDIO);
- Review of two papers for MathReviews.

Isabel Correia:

- Organizer of the Operations Research Seminars in 2013;
- Collaborator of EXPO2013, open day of FCT-UNL for high school students.

Maria Isabel Gomes:

- "Modelo integrado para projecto e planeamento de cadeias de abastecimento com fluxos de retorno", poster in MATER Exhibition, in the scope of Mathematics of Planet Earth 2013, FCT-UNL, October to December 2013;
- "A Matemática para o lixo", talk presented at EXPO2013, open day of FCT-UNL for high school students;
- "A optimização combinatória na reestruturação das cadeias de abastecimentos: o caso da Jerónimo Martins", talk presented at Matemática na FCT. Matemática na FCT is a course for the Mathematics students where in each session a person is invited to give a talk.

Nelson Chibeles-Martins: member of the organizing committee of ClubeMath, FCT-UNL Mathematics Club for pre-university students.

Susana Baptista:

- Member of the organizing committee of ClubeMath, FCT-UNL Mathematics Club for pre-university students;
- Activity leader in the exhibition MATER, in the scope of Mathematics of Planet Earth 2013.

(ii) Peer-reviewing activities

Ana Luísa Custódio:

- Referee for Annals of Operations Research;
- Referee for Journal of Optimization Theory and Applications;
- Referee for MOPTA 2012 Conference Proceedings;
- Referee for Optimization Methods and Software;

- Referee for SIAM Journal on Optimization.

Carmo Proença Brás:

- Referee for Mathematical Problems in Engineering.

Isabel Correia:

- Referee for Computers & Operations Research;
- Referee for Operational Research: An International Journal;
- Referee for Transportation Research – Part E: Logistics and Transportation Review;
- Referee for Transportation Science.

Manuel Valdemar Cabral Vieira:

- Referee for Numerical Algorithms;
- Referee for RAIRO - Operations Research.

Maria Isabel Gomes:

- Referee for Annals of Operations Research;
- Referee for Computers & Operations Research;
- Referee for Engineering Optimization;
- Referee for International Journal of Production Research.

Paula Amaral:

- Referee for Applied Mathematics and Computation;
- Referee for European Journal of Operational Research;
- Referee for International Journal of Production Research;
- Referee for Journal of Applied Mathematics and Computing;
- Referee for Mathematical Problems in Engineering.

(iii) Supervisions of Ph.D. (2013)

Isabel Correia: co-adviser of Bernardo de Almeida who is working on project scheduling problems with flexible resources.

Maria Isabel Gomes: co-adviser of Bruna Mota. The thesis is about *Incorporating the three pillars of sustainability into supply chain design and planning*.

(iv) Editing (of books and journals)

Ana Luísa Custódio was guest editor of the Proceedings of the National Meeting of the Portuguese Mathematical Society, Faro, July 2012. Publication's date: 2013.

Ana Luísa Custódio and Isabel Correia are the editors of the Portuguese Mathematical Society Bulletin, since 2012.

6. 4. Statistics and Risk Management Team

Integrated Members

- Ayana Maria Xavier Furtado Mateus
- Carla Maria Lopes da Silva Afonso dos Santos
- Carlos Manuel Agra Coelho
- Célia Maria da Silva Fernandes
- Dina Maria Morgado Salvador
- Dora Susana Raposo Prata Gomes
- Elsa Estevão Fachadas Nunes Moreira
- Filipe José Gonçalves Pereira Marques
- Francisco Paulo Vilhena Antunes Bernardino Carvalho
- Frederico Almeida Gião Gonçalves Caeiro
- Gonçalo José Nunes dos Reis
- Gracinda Rita Diogo Guerreiro
- Inês Jorge da Silva Sequeira
- João Beleza Teixeira Seixas e Sousa
- João Filipe Lita da Silva
- João Tiago Praça Nunes Mexia
- José Moniz Lopes Fernandes
- Luís Miguel Lindinho da Cunha Mendes Grilo
- Luís Pedro Carneiro Ramos
- Manuel Leote Tavares Inglês Esquível
- Maria de Fátima Varregoso Miguens
- Maria de Lourdes Belchior Afonso
- Marta Cristina Vieira Faias Mateus
- Miguel Brás de Carvalho
- Miguel dos Santos Fonseca
- Paulo Jorge Canas Rodrigues
- Paulo José Raimundo Ramos
- Pedro José dos Santos Palhinhas Mota
- Ricardo Jorge Viegas Covas
- Rui Manuel Rodrigues Cardoso
- Vanda Marisa da Rosa Milheiro Lourenço

- Vera da Conceição Vilelas Montes de Jesus

Collaborators Members

- Adilson de Jesus Martins da Silva (Ph.D. student)
- Alberto Adrego Pinto
- Carlos Manuel Antunes Veiga
- Célia Maria Pinto Nunes
- Clarinda Vitorino Nhangumbe (Ph.D. student)
- Cláudia Vanessa Rosa Leitão de Macedo Roçadas
- Cristina Paula da Silva Dias
- Dário Jorge da Conceição Ferreira
- Iola Maria Silvério Pinto
- Jarafe Augusto Abdala (Ph.D. student)
- Paula Cristina Pires Simões (Ph.D. student)
- Philippe Laurent Didier
- Ricardo Pinto Moura (Ph.D. student)
- Rita Cristina Pinto de Sousa
- Rui Manuel Pesado Alberto
- Rute Alexandra Baião Carrujo (Ph.D. student)
- Sandra Cristina Dias Nunes
- Sandra Inês da Cunha Monteiro (Ph.D. student)
- Sandra Maria Bargão Saraiva Ferreira
- Sandra Maria Simões de Oliveira (Ph.D. student)

6. 4. 1. Funding, Source, Dates

Projects led by team SRM members:

	Project Title	Principal Investigator	Team Members	Period	Total Funding
1. PTDC/AGR-PRO/2335/2012	STATinGEN - STRategies to Analyze and To detect INconsistent Genotypic responses to ENvironmental factors	Paulo Jorge Canas Rodrigues	Vanda Marisa da Rosa Milheiro Lourenço	2013-2015	32.283,00 (AEIC)

2. PTDC/MAT-STA/0568/2012	ROBSTATGEN, Robust methods in statistical genetics	Vanda Marisa da Rosa Milheiro Lourenço	Paulo Jorge Canas Rodrigues	2013-2015	40.000 € (FFCT/UNL)
3. Fondecyt Project 11121186	Constrained Inference Problems in Extreme Value Modeling	Miguel Brás de Carvalho		2012-2015	79.858 € (Chilean NSF)

Projects led by other institutions, with participation of team SRM members, eventually with no budget in our institution:

	Project Title	Principal Investigator	Team Members	Period	Total Funding
1. Project number 226544	"Models for adaptive forest management"	José G. Borges	Ayana Furtado	2009-2013	9.071 € (European Commission)
2. PTDC/MAT/101736/2008	"Extrema: statistical extremes in today's world"	Maria Ivette Leal de Carvalho Gomes	Dora Susana Raposo Prata Gomes and Frederico Almeida Caeiro	2010-2013	89.520 € (UL)
3. PTDC/EGE-ECO/108481/2008	"Evaluation of dividend barrier variables in the actuarial dual risk model"	Alfredo Duarte Egídio dos Reis	Rui Manuel Rodrigues Cardoso and Maria de Lourdes Afonso	2010-2013	21.510 € (UTL)
4. UTA_CMU/MAT/0006/2009	"Stochastic analysis and numerical approximations in mathematical finance"	Cláudia Rita Ribeiro Coelho Nunes Philippart	Gonçalo dos Reis	2011-2014	—
5. ECO2012-38860-C02-01	"Competencia, Cooperación y Negociación en la Formación de Precios"	Emma Moreno-García	Marta Cristina Vieira Faías Mateus	2013-2015	15.000 € (Ministerio de Economía y Competitividad)
6. PTDC/GEO-MET/3476/2012	"Predictability assessment and hybridization of seasonal drought forecasts in western Europe"	Carlos Alberto Leitão Pires	Dora Susana Raposo Prata Gomes and Elsa Estevão Fachadas Nunes Moreira	2013-2015	90.000 € (FFC/FC/UL)
7. PTDC/EPH-HIS/3697/2012	"Counting colonial populations. Demography and the use of statistics in the Portuguese Empire, 1776-1875"	Paulo dos Mártires Lopes Teodoro de Matos	Miguel dos Santos Fonseca	2012-2014	75.929 € (FCSH/UNL)
8. 539872-LLP-1-2013-1-IT-COMENIUS-CMP	"MiMa- Mathematics in the Making"	Emmanuela Ughi	Susana Baptista(*), Nelson Chibeles-	2013-2014	369.851 €

		(Università degli Studi di Perugia-Italy)	Martins(*), Gracinda Guerreiro and Maria do Céu Soares(**)		
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(*) – Member of the OR team participating in this project.

(**) – Member of the DENA team participating in this project.

6. 4. 2. Objectives

Integrated Members:

Ayana Mateus: In many practical situations it is important to test for the randomness of a series of observations. Therefore the researcher work will be focused on comparing the power of several nonparametric statistics for testing the hypothesis of an independent and identically distributed sequence against different alternatives to the null hypothesis (systematic oscillation, different shapes for trend function, etc).

Carla Santos: Promoting statistical literacy among students of the Polytechnic Institute of Beja and high school students in the region of Beja through the organization of the exhibition "Explorística – Aventuras na Estatística" at ESTIG of Polytechnic Institute of Beja.

Dora Prata Gomes: Improve a procedure that allow not only to obtain more stable estimators but also enables the development of reduced bias estimators; Study how R can be used for modeling spatial extreme precipitation data. Study an adequate procedure for choosing the number of order statistics to be used in the estimation of parameters of rare events in real case studies.

Elsa Moreira: It will be tried the improvement of drought predictions through climatically driven Markov chains and log-linear models for drought class transitions, introducing of a new category representing the state of the atmospheric oceanic circulation indices, like NAO and AO. In case of Markov chains we will use the regime-switching Markov models, which combine two or more sets of model coefficients into one system. These Markov chains are calibrated and a set of probabilistic and categorical forecasts of drought classes is computed with skill evaluated.

Filipe Marques: Make a deepening of the studies related with development of near-exact distributions for likelihood ratio test statistics used test covariance structures under, real

and complex, multivariate Normal settings and of studies on arising problems in Distribution Theory. Study of sum and product of important distributions in the area of Extremes. Analysis of emerging issues in the area of growth models.

Francisco Carvalho: For 2014, one of the main objectives will be continue the ongoing research, namely the study of models with commutative orthogonal block structure, discarding some of the initial restrictions, along with the organization of some events, namely LinStat'2014 – International Conference on Trends and Perspectives in Linear Statistical Inference (organizing committee) and the third Symposium on Statistical Inference in Linear Models (organizer).

Inês Sequeira: We will study models for the analysis of seroprevalence of toxoplasmosis and rubella in pregnant women attending at Laboratório de Patologia Clínica do Hospital Universitário de Brasília.

Marta Faias: In endogenous formation of trading markets, we explore the properties of the equilibrium, namely, agent's welfare and whether or not the markets are incomplete. We revisit stability in competition by means of a game with incomplete information in types and where firms compete in prices. Our aim is to provide new insights to the phenomenon of price dispersion, Bertrand's paradox and monopolistic competition.

Miguel Brás de Carvalho: To start to work in Astrostatistics with the Department of Astronomy.

Paulo Canas Rodrigues: Intend to continue research on statistical genetics-namely in the study of genotype by environment interaction, QTL by environment interaction and robust statistical methods-and in time series modeling with emphases on singular spectrum analysis.

Ricardo Covas: For 2014, one of the main objectives will be continue the ongoing research, namely the study of models with commutative orthogonal block structure, discarding some of the initial restrictions.

Rui Rodrigues Cardoso: To extend the results for ruin probabilities, time to ruin and expected present dividend amounts for the dual risk model considering generalized Erlang(n) and Phase-Type(n). Also we want pursue our research concerning the

calculation of the ruin probability for an auto insurance policy portfolio within a open bonus malus system.

Vanda Lourenço: For the year of 2014 it is expected to submit one to two more papers related to the project's activities. Results will be communicated throughout the year in high quality international conferences as well as in seminars and national meetings whenever possible – so far we have work accepted for presentation to the SSC, JSM and the IBC Florence meetings; two more abstracts have been submitted to COMPSAT and LinStat; an invitation to integrate an invited session submission at the SMTDA was accepted by the IR; work has already been presented at JOCLAD, WSMC8 and in an invited seminar at the Federal University of Bahia (UFBA), Brasil. The team also plans to apply for another project this year should the FCT rules make the IR eligible to apply.

Collaborators:

Sandra Nunes: To start working in Extreme Value Theory and develop the work already begun in order to publish some articles. Also, to continue the collaboration with colleagues from the fields of economics and management in order to apply the statistical techniques in these areas.

6. 4. 3. Main Achievements

Highlights:

Miguel Brás de Carvalho was elected (early 2014) member of the International Statistical Institute.

Paulo Canas Rodrigues nominated to be Co-chair of the Young Statisticians Committee of the International Statistical Institute, the biggest international statistical association; Nominated to be Co-editor of the scientific journal Biometrical Letters; Nominated to be Managing Editor of the journal Statistics, Optimization and Information Computing.

Achievements by Integrated Members:

Ayana Mateus: We developed her work around the power of some non-parametric randomness tests through a Monte Carlo simulation study.

Dora Prata Gomes: A general method for estimating the "optimal" block length for resampling in the situation of dependence was used in a simulation study for estimating

a parameter of extreme events. Two estimators of that parameter were used and bootstrap versions of those estimators based on a block resampling scheme were considered. Estimates from the Generalized Jackknife estimator revealed promising results, showing a more stable path. A heuristic algorithm reveals to perform quite well for the choice of the number of upper order statistics to be used in the adaptive estimation of extremal value index and extremal index, either through the classical or the reduced-bias estimators.

Elsa Moreira: Drought in Portugal was assessed using 74 time series of Standardized Precipitation Index (SPI) 66 years length. A clustering analysis on the SPI Principal Components loadings was performed in order to find regions where SPI drought characteristics are similar. A Fourier analysis was then applied to the SPI time series included in each cluster to investigate the existence of cycles that could represent the return periods of droughts.

New developments on the approach of the F tests under the assumption of Poisson distributed sample sizes were made. Simulations on the power analysis led us to conclude that these tests are more powerful than the usual F tests. They have also a very useful application in a phase of planning studies to obtain the minimum duration of data collection to ensure a test with elevate power. Were also made some advances in the extension of the F test with random sample sizes to mixed linear models.

Filipe Marques: Conclusion of various works concerning the development of near-exact distributions for likelihood ratio test statistics used test the different forms of covariance structures under the, real and complex, multivariate Normal settings.

Derivation of relevant results in the field of Distribution Theory in particular on products and sums of independent random variables.

Francisco Carvalho: During the year of 2013, the ongoing research continued to produce results. One of the visual effects of such work is measured in the publication of four papers in international journals and a pre-print with ongoing research. Besides the publication of papers, the organization of some events were also important on the development of the research activities, namely the presentation and discussion of the ongoing research, but also the wider opportunity for interchange of possible joint work with other researchers / institutions. As such, I organized the Second Symposium on Symposium on Statistical Inference in Linear Models, integrated in the International

Conference on Numerical Analysis and Applied Mathematics (Rhodes, Greece) and also member of the Organizing Committee of MATTRIAD'2013 – Workshop on Matrix Theory and its Applications, held at Herceg-Novi (Montenegro). Due to the success of such events, I was invited to organize in 2014 the Third Symposium on Statistical Inference in Linear Models and also the 2016 edition of 2014.

Inês Sequeira: A set of statistical techniques are used to the study of predominance of constitutional chromosomal rearrangements in human chromosomal fragile sites (CFSs). The results indicated a predominance of rearrangements in CFSs, the absence of statistically significant difference between the frequencies of rearrangements in common CFSs vs. rare CFSs and a predominance of deletions over duplications in CFSs.

Application of statistical methods, namely non-parametric tests and analysis of variance for analyzing two sets of data of HIV1 and HIV2 integrations in the human genome. The results show that the integrations occur significantly with more intensity in the non-fragile regions of the human genome and that the HIV1 in particular has the major contribution to this fact.

The results were published in 1 paper and 1 conference proceeding, respectively.

Marta Faias: By means of a Shapley-Shubik game provided strategic foundations for the Walrasian equilibrium of an economy with public goods.

We obtained an analogue of the neutrality result of Warr (1983) and Bergstrom, Blume and Varian (1986) for economies with both multiple private and public goods.

We prove existence of equilibrium and differentiability of the demands, in an economy with multiple exchanges and where the same security is listed in different exchanges.

Miguel Brás de Carvalho: The main achievements were made on applied statistics, extreme value statistics, and medical diagnostic data modeling. A main achievement in extreme value statistics was the development of a spectral density ratio model for multivariate extremes. In terms of diagnostic data modeling, the application of Bayesian nonparametric techniques has resulted in a publication at a leading journal in Bayesian statistics, and there is currently more work being developed in this direction. Finally, in terms of applied statistics I was able to develop interdisciplinary applications of the models being developed, with illustrations being given on forestry, economics, networks engineering, computational biology, and flood risk management.

Miguel Fonseca: Research was continued in estimation and hypothesis tests in linear univariate mixed models with restrictions on parameters, in both fixed and random ones. Also, research was made in estimation and hypothesis testing for complex multivariate mixed models with orthogonal covariance structure.

The development of prediction and analysis models for service demand for personal assistance for the ageing and disabled population was also started.

Paulo Canas Rodrigues: Several publications were finalized, the research network consolidated, one research project was approved for founding and outreach activities developed.

Ricardo Covas: During the year of 2013, the ongoing research continued to produce results. One of the visible effects of such work is measured in the publication of one paper in international journals.

Rui Rodrigues Cardoso: We obtained several results for ruin probabilities, time to ruin and expected present dividend amounts for the dual risk model considering that inter-time jumps follow an Erlang(n) distribution. Also we design a model to calculate the ruin probability for an auto insurance policy portfolio with a bonus malus system.

It was published a paper with **Lourdes B. Afonso** and Alfredo D. Egídio dos Reis, *Dividend problems in the dual risk model* in the journal Insurance: Mathematics and Economics 53 (3), 906-918.

Vanda Lourenço: In early 2013 the project ROBSTATGEN has officially started. Its first publication, concerning the first task, was resubmitted in early April. It had already been submitted in June 2012 but rejected in December. Some major improvements were made and it has now been accepted and already published online. Continuing work of the project progressed well during the rest of 2013, along with the first publication's successive revisions. In the second semester of 2013 we opened the 6 month grant call and prepared the announcement for the project's 12 month post-doc position call. Communication of the project's results was also delivered in international meetings.

6. 4. 4. Group Productivity

6. 4. 4. 1. Book Chapter

1. **Caeiro, F.** and Gomes M. I. (2013), *A Class of Semi-parametric Probability Weighted Moment Estimators*, Recent Developments in Modeling and Applications in Statistics, Studies in Theoretical and Applied Statistics, Selected Papers of the Statistical Societies, Berlin: Springer, 139-147.

URL: http://link.springer.com/chapter/10.1007/978-3-642-32419-2_15

2. **Caeiro, F.** and Gomes, M. I. (2013), *Asymptotic Comparison at Optimal Levels of Minimum-Variance Reduced-Bias Tail-Index Estimators*, Advances in regression, survival analysis, extreme values, Markov processes and other statistical applications, Studies in Theoretical and Applied Statistics, Selected Papers of the Statistical Societies, Berlin: Springer 2013, 83-91.

URL: http://link.springer.com/chapter/10.1007%2F978-3-642-34904-1_8

3. **Carvalho, F., Mexia, J. T.,** Bapat, Ravindra B.(ed.) et al. (2013), *Inference in error orthogonal models*, Combinatorial matrix theory and generalized inverses of matrices, New Delhi: Springer, 85-100.

URL: http://link.springer.com/chapter/10.1007%2F978-81-322-1053-5_8

4. Gomes, M. I., Henriques-Rodrigues, L. and **Caeiro, F.** (2013), *Refined Estimation of a Light Tail: an Application to Environmental Data*, in Torelli, N., Pesarin, F., Bar-Hen, A. (Eds.), Advances in Theoretical and Applied Statistics, Springer, 2013, XIX, 143-153.

URL: http://link.springer.com/chapter/10.1007%2F978-3-642-35588-2_14#page-1

5. **Marques, F. J., Coelho, C. A.** and Marques, P. (2013), *The Block-Matrix Sphericity Test: Exact and Near-exact Distributions for the Test Statistic*, in Recent Developments in Modeling and Applications in Statistics – Studies in Theoretical and Applied Statistics: Selected Papers of the Statistical Societies, Oliveira, P. E., Temido, M. G. and Henriques, C. (eds.), International Book Series, Springer, 169-177.

URL: http://link.springer.com/chapter/10.1007%2F978-3-642-32419-2_18

6. **Mateus, A.** and Tomé, M. (2013), *Fitting Johnson's SB distribution to forest tree diameter*, Advances in regression, survival analysis, extreme values, Markov processes

and other statistical applications, Studies in Theoretical and Applied Statistics, Selected Papers of the Statistical Societies, Berlin: Springer, 289-296.

URL: http://link.springer.com/chapter/10.1007/978-3-642-34904-1_30

7. **Miguens, M., Guerreiro, G. and Mexia, J. T.** (2013), *Preliminary results on confidence intervals for open bonus malus*, Advances in regression, survival analysis, extreme values, Markov processes and other statistical applications, Studies in Theoretical and Applied Statistics, Selected Papers of the Statistical Societies, Berlin: Springer, 223-230.

URL: http://link.springer.com/chapter/10.1007%2F978-3-642-34904-1_23

8. Nunes, C., Ferreira, D., Ferreira, S. S. and **Mexia, J. T.** (2013), *Generalized F tests in models with random perturbations: the truncated Normal case*, Advances in Regression, Survival Analysis, Extreme Values, Markov Processes and other Statistical Applications, Studies in Theoretical and Applied Statistics, 307-315. Selected papers of the Statistical Societies. Lita da Silva, J.; Caeiro, F.; Natálio, I.; Braumann, C.A. (Editors).

URL: http://link.springer.com/chapter/10.1007/978-3-642-34904-1_32

9. **Prata Gomes, D., Mexia, J. T.** and Neves, M. (2013), *Simulation Study of the Calibration Technique in the Extremal Index Estimation*, Studies in Theoretical and Applied Statistics, Subseries B "Selected Papers of the Statistical Societies", Advances in Regression, Survival Analysis, Extreme Values, Markov Processes and Other Statistical Applications, 381-389.

URL: http://link.springer.com/chapter/10.1007%2F978-3-642-34904-1_40

6. 4. 4. 2. Publications in Peer Review Journals

1. **Afonso, M., Cardoso, R.** and Egidio dos Reis, Alfredo D. (2013), *Dividend problems in the dual risk model*, Insurance Mathematics & Economics, 53 (3), 906-918 [Impact factor = 1.095].

URL: <http://www.sciencedirect.com/science/article/pii/S0167668713001571>

2. Alimi, N. A., Bink, M. C., Dieleman, J. A., Nicolai, M., Wubs, M., Heuvelink, E., Magan, J., Voorrips, R. E., Jansen, J. and **Rodrigues, P. C.** (2013), *Genetic and QTL analyses of yield and a set of physiological traits in pepper*, Euphytica, 190 (2), 181-201 [Impact factor = 1.643].

URL: <http://link.springer.com/article/10.1007%2Fs10681-012-0767-0>

3. Arnold, B. C., **Coelho, C. A.** and **Marques, F. J.** (2013), *The distribution of the product of powers of independent uniform random variables - A simple but useful tool to address and better understand the structure of some distributions*, Journal of Multivariate Analysis, 113, 19-36 [Impact factor =1.063].

URL: <http://www.sciencedirect.com/science/article/pii/S0047259X11000625>

4. **Coelho, C. A.** (2013), *George P. H. Styan - a celebration*, Discussiones Mathematicae Probability and Statistics, 33, 7-29.

URL: <http://www.discuss.wmie.uz.zgora.pl/ps/index.php?doi=10.7151/dmps.1156>

5. **Coelho, C. A.** and **Marques, F. J.** (2013), *The Multi-Sample Block-Scalar Sphericity Test: Exact and Near-Exact Distributions for Its Likelihood Ratio Test Statistic*, Communications in Statistics-Theory and Methods, 42 (7), 1153-1175 [Impact factor = 0.298].

URL: <http://www.tandfonline.com/doi/abs/10.1080/03610926.2012.704542#.U3NGP4FdXPA>

6. **da Silva, J. L.** and **Mexia, J. T.** (2013), *Strong consistency of least squares estimates with i.i.d. errors with mean values not necessarily defined*, Statistics, 47 (4), 707-714 [Impact factor = 1.258].

URL: <http://www.tandfonline.com/doi/pdf/10.1080/02331888.2011.581759>

7. **de Carvalho, M.**, Oumow, B., Segers, J. and Warchol, M. C. (2013), *A Euclidean likelihood estimator for bivariate tail dependence*, Communications in Statistics-Theory and Methods, 42 (7), 1176-1192 [Impact factor = 0.298].

URL: <http://www.tandfonline.com/doi/pdf/10.1080/03610926.2012.709905>

8. de Carvalho, V., Jara, A., Hanson, T. E. and **de Carvalho, M.** (2013), *Bayesian nonparametric ROC regression modeling*, Bayesian Anal., 8 (3), 623-646 [Impact factor = 2.417].

9. **de Carvalho, M.**, Turkman, K. F. and Rua, A. (2013), *Dynamic Threshold Modelling and the US Business Cycle*, Journal of the Royal Statistical Society, Ser. C, 62 (4), 535-550 [Impact factor = 1.253].

URL: <http://onlinelibrary.wiley.com/doi/10.1111/rssc.12008/abstract>

10. **de Carvalho, M.**, Turkman, K. F. and Rua, A. (2013), *Nonstationary extremes and the US business cycle*, Journal of the Royal Statistical Society, Ser. C, 62, 535-550 [Impact factor = 1.253].

11. **dos Reis, G.** and dos Reis, Ricardo J. N. (2013), *A note on comonotonicity and positivity of the control components of decoupled quadratic FBSDE*, Stochastic and Dynamics, 13 (4), 11 pages [Impact factor = 0.358].

URL: <http://www.worldscientific.com/doi/abs/10.1142/S0219493713500056>

12. **Esquivel, M. L.**, Dimas, L., **Mexia, J. T.** and **Didier, P.** (2013), *Small perturbations with large effects on Value at Risk*, Discussiones Mathematicae Probability and Statistics, 33 (1-2), 151-153.

URL: <http://www.discuss.wmie.uz.zgora.pl/ps/index.php?doi=10.7151/dmps.1148>

13. **Fernandes, C.**, **Ramos, P.** and **Mexia, J. T.** (2013), *Cobs and stair nesting-segregation and crossing*, Far East J. Math. Sci. (FJMS), 78 (2), 301-308.

URL: <http://www.pphmj.com/abstract/7803.htm>

14. Ferreira, S. S., Ferreira, D., Nunes, C. and **Mexia, J. T.** (2013), *Estimation of variance components in linear mixed models with commutative orthogonal block structure*, Revista Colombiana de Estadística, 36 (2), 261-271 [Impact factor = 0.109].

15. **Fonseca, M.** and **Mexia, J. T.** (2013), *Delta Method, Moment Convergence, and Inference*, Communications in Statistics-Theory and Methods, 42 (12), 2165-2171 [Impact factor = 0.298].

16. Frei, C. and **dos Reis, G.** (2013), *Quadratic FBSDE with generalized Burgers type nonlinearities, perturbations and large deviations*, Stochastic and Dynamics, 13 (2), 37 pages [Impact factor = 0.358].

URL: <http://www.worldscientific.com/doi/abs/10.1142/S0219493712500153>

17. **Marques, F. J. and Coelho, C. A.** (2013), *Obtaining the exact and near-exact distributions of the likelihood ratio statistic to test circular symmetry through the use of characteristic functions*, Computational Statistics, 28 (5), 2091-2115 [Impact factor = 0.482].

URL: <http://link.springer.com/article/10.1007%2Fs00180-013-0398-5>

18. **Moreira, E., Mexia, J. T. and Pereira, L. S.** (2013), *Assessing homogeneous regions relative to drought class transitions using an ANOVA-like inference*, Application to Alentejo, Portugal, Stochastic Environmental Research and Risk Assessment, 27 (1), 183-193 [Impact factor = 1.961].

URL: <http://link.springer.com/article/10.1007%2Fs00477-012-0575-z>

19. **Moreira, E., Mexia, J. T. and Minder, C.** (2013), *F tests with random sample sizes*, Theory and applications, Statistics & Probability Letters, 83 (6), 1520-1526 [Impact factor = 0.531].

URL: <http://www.sciencedirect.com/science/article/pii/S0167715213000709>

20. Nunes, C., Oliveira, M. M. and **Mexia, J. T.** (2013), *Application domains for the Delta method*, Statistics, 47 (2), 317-328 [Impact factor = 1.258].

URL: <http://www.tandfonline.com/doi/abs/10.1080/02331888.2011.605892#.U3NuPoFdUik>

21. **Rodrigues, P. C. and de Carvalho, M.** (2013), *Preface* (Editorial for the Special Issue devoted to the 17th edition of the European Young Statisticians Meetings), Communications in Statistics-Theory and Methods, 42 (7), 1143-1144 [Impact factor = 0.298].

URL: <http://www.tandfonline.com/doi/pdf/10.1080/03610926.2013.759778>

22. **Rodrigues, P. C. and de Carvalho, M.** (2013), *Spectral modeling of time series with missing data*, Applied Mathematical Modelling, 37 (7), 4676-4684 [Impact factor = 1.706].

URL: <http://www.sciencedirect.com/science/article/pii/S0307904X12005379>

6. 4. 4. 3. Papers Accepted in Peer Review Journals

1. **de Carvalho, M.** and Davison, A. C., *Spectral density ratio models for multivariate extremes*, to appear in Journal of the American Statistical Association [Impact factor = 1.834].

2. **de Carvalho, M.** and Rua, A., *Extremal dependence of international output growth: Tales from the tails*, to appear in Oxford Bulletin of Economics and Statistics (Article first published online: 28 April 2013) [Impact factor = 0.707].

URL: <http://onlinelibrary.wiley.com/doi/10.1111/obes.12032/abstract;jsessionid=6B555B0214E6CEBFBDE29966E5D57957.f02t03?systemMessage=Wiley+Online+Library+will+be+disrupted+Saturday%2C+7+June+from+10%3A00-15%3A00+BST+%2805%3A00-10%3A00+EDT%29+for+essential+maintenance>

3. **Esquivel, M. L.** and **Mota P.**, *On some auto-induced regime switching double threshold glued diffusions*, to appear in Journal of Statistical Theory and Practice (Accepted author version posted online: 23 October 2013, Published online: 23 May 2014).

4. **Faias, M.**, Moreno-García, E. and Wooders, M., *A strategic market game approach for the private provision of public goods*, to appear in Journal of Dynamics and Games.

5. **Marques, F. J.**, **Coelho, C. A.** and **de Carvalho, M.**, *On the distribution of linear combinations of independent Gumbel random variables*, to appear in Statistics and Computing [Impact factor = 1.977].

URL: <http://link.springer.com/article/10.1007%2Fs11222-014-9453-5>

6. **Ramos, L.**, **Mota, P.** and **Mexia, J. T.**, *Sample partitioning estimation for ergodic diffusions*, to appear in Communications in Statistics-Simulation and Computation [Impact factor = 0.295].

7. **Rodrigues, P. C.**, **Moreira, E. E.**, **Jesus, V. M.** and **Mexia, J. T.** (2013), *Structured orthogonal families of one and two strata prime basis factorial models*, Statistical Papers (published online 16 February 2013) [Impact factor = 0.683].

URL: <http://link.springer.com/article/10.1007%2Fs00362-013-0507-0>

6. 4. 4. 4. Papers Submitted to Peer Review Journals

1. **Moreira, E. E.**, Martins, D. S. and Pereira, L. S., *Assessing drought cycles in SPI time series using a Fourier analysis*, submitted to Natural Hazards and Earth System Sciences (accepted as discussion paper in Natural Hazards and Earth System Sciences) [Impact factor = 1.751].
2. Nunes C., Ferreira D., Ferreira S. S., **Moreira E.** and **Mexia J.T.**, Mixed models a with random sample sizes, submitted to Computational Statistics & Data Analysis [Impact factor = 1.304].
3. Oberhauser, H. and **dos Reis, G.**, *Root's barrier, viscosity solutions of obstacle problems and reflected FBSDEs*.
URL: <http://arxiv.org/abs/1301.3798>

6. 4. 4. 5. Other International Publications

6. 4. 4. 5. 1. Conference Proceedings with Peer-Review

1. Areia, A. and **Carvalho, F.** (2013), *Perfect families: An application to orthogonal and error orthogonal models*, AIP Conference Proceedings, 1558, 841.
URL: <http://scitation.aip.org/content/aip/proceeding/aipcp/10.1063/1.4825627>
2. **Caeiro, F.** and Gomes M. I. (2013), *On the Selection of the Tuning Parameter of a Moment Estimator of the Extreme Value Index*, 11th International Conference of Numerical Analysis and Applied Mathematics 2013: ICNAAM 2013, AIP Conference Proceedings, 1558, 801-804.
URL: <http://adsabs.harvard.edu/abs/2013AIPC.1558..801C>
3. **Caeiro, F.** and Gomes, M. I. (2013), *The Role of Bootstrap Methodologies in the Estimation of a Negative Extreme Value Index*, Proceedings 59th ISI World Statistics Congress, 25-30 August 2013, Hong Kong (Session IPS010), 103-108.
URL: <http://2013.isiproceedings.org/Files/IPS010-P3-S.pdf>
4. **Carvalho, F.** and **Covas, R.** (2013), *Models with homoscedastic orthogonal partition, BQUE and mixed models*, AIP Conference Proceedings, 1558, 847.
URL: <http://scitation.aip.org/content/aip/proceeding/aipcp/10.1063/1.4825628>

5. **Carvalho, F.** (2013), *Preface of the “Second symposium on statistical inference in linear models”*, AIP Conference Proceedings, 1558, 817.

URL: <http://scitation.aip.org/content/aip/proceeding/aipcp/10.1063/1.4825620>

6. **Coelho, C. A. and Marques, F. J.** (2013), *Near-exact Distributions for the Block Equicorrelation and Equivariance Likelihood Ratio Test Statistic*, AIP Conference Proceedings, 1557, 429.

URL: <http://scitation.aip.org/content/aip/proceeding/aipcp/10.1063/1.4823950>

7. **Furtado, A. and Caeiro, F.** (2013), *Comparing several tests of randomness based on the difference of observations*, 1th International Conference of Numerical Analysis and Applied Mathematics 2013: ICNAAM 2013, AIP Conference Proceedings, 1558, 809.

URL: <http://scitation.aip.org/content/aip/proceeding/aipcp/10.1063/1.4825618>

8. **Grilo, L. and Coelho, C. A.** (2013), *A near-exact distributions for the likelihood ratio statistic used to test the reality of a covariance matrix*, 11th International Conference of Numerical Analysis and Applied Mathematics (ICNAAM 2013), AIP Conference Proceedings, 1558, 797.

URL: <http://scitation.aip.org/content/aip/proceeding/aipcp/10.1063/1.4825615>

9. **Marques, F. J. and Coelho, C. A.** (2013), *The multi-sample block-scalar sphericity test under the complex multivariate Normal case*, International Conference on Mathematical Sciences and Statistics 2013 (ICMSS2013), Proceedings of the International Conference on Mathematical Sciences and Statistics 2013, AIP Conference Proceedings, 1557, 420-423.

URL: <http://adsabs.harvard.edu/abs/2013AIPC.1557..420M>

10. **Moreira, E., Martins D. S., Pereira, L.S. and Mexia, J. T.** (2013), *Assessing drought cycles using a Fourier analysis*, Proceedings of the 1st CIGR Inter-Regional Conference on Land and Water Challenges, Bari, Italy.

11. **Prata Gomes, D. and Neves, M.** (2013), *Reduced bias and threshold choice in the extremal index estimation through resampling techniques*, 11th International Conference of Numerical Analysis and Applied Mathematics 2013: ICNAAM 2013, AIP Conference Proceedings, 1558, 805-808.

URL: <http://adsabs.harvard.edu/abs/2013AIPC.1558..805G>

12. **Sequeira, I.**, Gonçalves, J., **Moreira, E.**, **Mexia, J. T.**, Rueff, J. and Brás, A. (2013), *Genetic and statistical study of HIV integration in the human genome*, AIP Conf. Proc., ICNAAM 2013 - 11th International Conference of Numerical Analysis and Applied Mathematics, Rhodes, Greece, 1558, 813.

URL: <http://scitation.aip.org/content/aip/proceeding/aipcp/10.1063/1.4825619>

13. Silva, A., **Carvalho, F.**, **Mexia, J. T.** and **Fonseca, M.** (2013), *One-sided tolerance interval in a two-way balanced nested model with mixed effects*, AIP Conference Proceedings, 1558, 818.

URL: <http://scitation.aip.org/content/aip/proceeding/aipcp/10.1063/1.4825621>

6. 4. 4. 6. Other National Publications

Caeiro, F. and Gomes, M. I. (2013), *Estatística de Extremos Univariados: Modelos Paramétricos vs Não-Paramétricos*, Boletim da SPE, Primavera de 2013, 51- 60.

6. 4. 4. 7. Contributions for Articles with Discussion

de Carvalho, M. and Page, G. L. (2013), *Discussion of "How to find an appropriate clustering for mixed type variables with application to socio-economic stratification"*, by Hennig, C. & Liao, T. F., Journal of the Royal Statistical Society, Ser. C, 62, 343-344 [Impact factor = 1.253].

6. 4. 4. 8. Computer code

Manjunath, B. G. and **Caeiro, F.** (2013), *evt0: Mean of order p , peaks over random threshold Hill and high quantile estimates*. Version 1.1-3 (24/12/2013).

URL: <http://cran.r-project.org/web/packages/evt0/index.html>

6. 4. 4. 9. Report

1. **Guerreiro, G.** and **Afonso, M.** (2013), *Avaliação Actuarial do Regime de Pensões da Caixa Geral de Aposentações-Formulação Actual e Impacto das Medidas Legislativas*, Official Government Report 2013.

6. 4. 4. 10. M.Sc. Theses Completed

Edgar Ferreira Enes

A educação como contributo para a redução das diferenças de expectativas em auditoria: o caso português, Instituto Politécnico de Tomar, 7 December 2013. Master in Auditing and Financial Analysis.

Supervisor: **Francisco Carvalho**

Juliana Gonçalves

Características do genoma humano associadas à integração do HIV - análise bioinformática, Faculdade de Ciências e Tecnologia, Universidade Nova de Lisboa, Master in Genética Molecular e Biomedicina, 18 December 2013.

Supervisors: Aldina Brás, **Elsa Moreira** and **Inês Sequeira**

Rodrigo Rubio

Predictor-Dependent Inequality Modeling, Pontificia Universidad Catolica de Chile, 1 December 2013.

Supervisors: **Miguel Brás de Carvalho** and Dr. A. F. Barrientos.

Sitsofe Tsagbey

What's Wrong with Fishery Official Statistics?, Pontificia Universidad Catolica de Chile, 5 December 2013.

Supervisors: **Miguel Brás de Carvalho** and Dr. G. L. Page.

6. 4. 4. 11. Ph.D. Theses Completed

Dina Maria Morgado Salvador

Modelação de Matrizes Estocásticas Simétricas: Operadores do tipo vec, Faculdade de Ciências e Tecnologia, Universidade Nova de Lisboa, 18 December 2013.

Supervisors: **João Tiago Praça Nunes Mexia**.

João Beleza Teixeira Seixas e Sousa

Machine Learning Gaussian Short Rate, Faculdade de Ciências e Tecnologia, Universidade Nova de Lisboa, 4 December 2013.

Supervisors: **Manuel Leote Tavares Inglês Esquível** and Raquel Medeiros Gaspar.

Rita Cristina Pinto de Sousa

Parameter Estimation in the Presence of Auxiliary Information, Faculdade de Ciências e Tecnologia, Universidade Nova de Lisboa, 22 November 2013.

Supervisors: Sat Gupta and **João Tiago Praça Nunes Mexia**.

6. 4. 5. Internationalization

Filipe Marques: Collaboration with Professor Barry C. Arnold, Distinguished Professor at University of California, Riverside, in the paper Arnold, B. C., **Coelho, C. A.** and **Marques, F. J.** (2013), *The distribution of the product of powers of independent uniform random variables - A simple but useful tool to address and better understand the structure of some distributions*, Journal of Multivariate Analysis, 113, 19-36 and in the Edition (still in development) of the Special Volume of the Journal of Statistical Theory and Practice, entitled "Distribution Theory, Estimation and Inference", dedicated to the 10th International Conference of Numerical Analysis and Applied Mathematics with guest editors Barry C. Arnold, Carlos A. Coelho and Filipe J. Marques.

Francisco Carvalho: Collaborative publications is an ongoing research project, involving namely Prof Augustyn Markiewicz (sufficient and complete statistics and best quadratic unbiased estimators); Prof Roman Zmyslony (normal orthogonal block structure; mean driven balance and uniformly best linear unbiased estimators) and Anuradha Roy with models with doubly exchangeable distributed errors.

Inês Sequeira: Collaboration with Yanna Karla de Medeiros Nóbrega, Ph.D., Professor, Department of Pharmaceutical Sciences, University of Brasilia, School of Health Sciences.

Marta Faias: Collaborative research work with Professor Emma Moreno-García from Universidade de Salamanca, Spain, Professor Myrna Wooders from Vanderbilt University, USA, and Jaime Luque from University of Wisconsin – Madison, USA.

Miguel Brás de Carvalho: Visited Prof. A. C. Davison (Ecole Polytechnique Fédérale de Lausanne) and Prof. J. Segers (Université catholique de Louvain), during the February summer break. Internationalization has resulted in the development of networking and it has provided the opportunity to contact with other research topics.

Paulo Canas Rodrigues: Visiting Fellow at Departamento de Estatística e Experimentação Agronômica, ESALQ, University of São Paulo, Brazil, 5-11 May 2013.

Ricardo Covas: Collaborative publications is an ongoing research project, involving namely Prof Roman Zmyslony (normal orthogonal block structure; mean driven balance and uniformly best linear unbiased estimators).

Rui Rodrigues Cardoso:

- Member of Organizing Committee of IV Iberian Congress of Actuaries, Barcelona, 20 June;
- Member of Scientific Committee of IV Iberian Congress of Actuaries, Barcelona, 20 June.

(i) Invited talks at international conferences

1. **Caeiro, F.**, *Computational study of a bootstrap algorithm for the adaptive estimation of the extreme value index*, in organized Session ES32: Bias reduction in statistics of extremes, CFE-ERCIM 2013, 14-16 December 2013, Senate House, University of London, UK.

2. **Caeiro, F.** and Gomes, M. I., *The Role of Bootstrap Methodologies in the Estimation of a Negative Extreme Value Index*, Proceedings 59th ISI World Statistics Congress, 25-30 August 2013, Hong Kong (Session IPS010), 103-108.

URL: <http://2013.isiproceedings.org/Files/IPS010-P3-S.pdf>

3. **Caeiro, F.**, *Statistics of Univariate Extremes: an Overview and Open Research Topics*, 7th Workshop on Statistics, Mathematics and Computation, 28-29 May 2013, Tomar, Portugal.

4. **de Carvalho, M.**, Jornadas Nacionales de Estadística, Chile, 23-25 October 2013 (Invited speaker).

5. **Faias, M.**, IV Workshop on Equilibrium Analysis, Dipartimento di Scienze Economiche e Statistiche, Università degli Studi di Napoli Federico II, Naples, Italy, 25-26 January 2013.

6. **Faias, M.**, *On value allocations in economies with commodity differentiation*, International Conference and Advanced School Planet Earth, Dynamic, Games and Science II (DGS II 2013), Calouste Gulbenkian Foundation, Lisbon, Portugal, 2-4 September 2013 (Keynote Speaker).

7. **Faias, M.**, *Risk diversification across the exchanges with cross-listings*, VII Workshop on Economic Theory 2013, Vigo, Spain, 12-13 September 2013.

8. **Lourenço, V.**, *Robust outlier testing with application to a maize data set* at the CIM International Conferences and Advanced Schools Mathematics of Planet Earth Gulbenkian, 2-4 September, Lisboa, Portugal.
9. **Marques, F.**, *The Multisample Block-diagonal Equicorrelation and Equivariance test*, 11th International Conference of Numerical Analysis and Applied Mathematics, ICNAAM, Greece, 21-27 September 2013.
10. **Moreira, E., Mexia, J. T.** and Minder, C., *F tests with random sample size*, Power analysis and applications, 7th Workshop on Statistics, Mathematics and Computation, Tomar, Portugal.
11. **Prata Gomes, D.**, *Adaptive choice and resampling techniques in parameter estimation: Application to extreme data in finance and environment*, 5th International Conference on risk analysis (ICRA5), Polytechnic Institute of Tomar, 30-31 May and 1 June 2013.
12. **Rodrigues, P. C.**, *Comparison of algorithms for weighted low-rank approximations and application to plant genetics*, Joint Meeting of the IASC Satellite Conference for the 59th ISI WSC and the 8th Conference of the Asian Regional Section of the IASC, Seoul, Korea, 22-23 August 2013.
13. **Rodrigues, P. C.**, *Low-rank approximations and weighted low-rank approximations*, 59th World Statistics Congress-ISI 2013, Hong Kong, 25-30 August 2013.
14. **Rodrigues, P. C.**, *The role of matrix analysis in statistical genetics*, Mat Triad 2013, Herceg Novi, Montenegro, 16-20 September 2013 (Keynote Speaker).
15. **Rodrigues, P. C.**, *An overview of singular spectrum analysis*, y-BIS 2013, Istanbul, Turkey, 19-21 September 2013.

(ii) Contributed talks at international conferences

1. **Caeiro, F.**, *A class of PPWM estimators of high quantiles*, 5th International Conference on Risk Analysis, Tomar, Portugal, 30 May-1 June 2013.

2. **Caeiro, F.** *On the Selection of the Tuning Parameter of a Moment Estimator of the Extreme Value Index*, ICNAAM2013 - 11th International Conference on Numerical Analysis and Applied Mathematics, Rhodes, Greece, 25 September 2013.
3. **Carvalho, F.**, *Orthogonal and error orthogonal models and perfect families*, Conference on Matrix Analysis and its Applications (MatTriad'2013), Herceg Novi, Montenegro, 16-20 September 2013.
4. **Carvalho, F.**, *Models with homoscedastic orthogonal partition, BQUE and mixed models*, International Conference on Numerical Analysis and Applied Mathematics (ICNAAM), 21-27 September 2013 (Rhodes, Greece).
5. **Carvalho, F.**, *One-sided tolerance interval in a two-way balanced nested model with mixed effects*, International Conference on Numerical Analysis and Applied Mathematics (ICNAAM), 21-27 September 2013 (Rhodes, Greece).
6. **Carvalho, F.**, *Perfect Families: an application to Orthogonal and Error Orthogonal Models*, International Conference on Numerical Analysis and Applied Mathematics (ICNAAM), 21-27 September 2013 (Rhodes, Greece).
7. Cunha, J., Alves, J., Carvalho, L., Correia, F., Farinha, L., Fernandes, J., Ferreira, M., Lucas, E., Nicolau, A., **Nunes, S.**, Nunes, S., Oliveira, P., Pereira, C., Pinto, S. and Silva, J. M. (2013), *The socio-economic impact of a Polytechnic Institution in a local economy: some insights of field research*, EAIR 35th Annual Forum in Rotterdam, Erasmus University of Rotterdam, the Netherlands, August 2013.
8. **Fonseca, M.**, *Modelos Lineares Mistos Não Normais – XX Congresso da Sociedade Portuguesa de Estatística*, Portugal, 2013.
9. **Fonseca, M.**, *Non-normal linear mixed models – MAT-TRIAD 2013*, Montenegro, 2013.
10. **Furtado, A.** and **Caeiro, F.**, *Comparing several tests of randomness based on the difference of observations*, 1th International Conference of Numerical Analysis and Applied Mathematics 2013: ICNAAM 2013, AIP Conference Proceedings, 1558, 809.
URL: <http://scitation.aip.org/content/aip/proceeding/aipcp/10.1063/1.4825618>

11. **Marques, F.**, *The multisample block-scalar sphericity test under the complex multivariate normal case*, International Conference on Mathematical Sciences and Statistics (ICMSS2013), Kuala Lumpur, Malaysia, 5-7 February 2013.
12. **Marques, F.**, *The multisample block-diagonal equicorrelation and equivariance test: A near-exact approach*, 6th International Conference of the ERCIM (European Research Consortium for Informatics and Mathematics) Working Group on Computational and Methodological Statistics (ERCIM 2013), London, 14-16 December 2013.
13. **Mexia, J. T., Carvalho, F. and Covas, R.** (2013), *Models with homocedastic orthogonal partitions, BQUE and mixed models*, ICNAAM 2013, Greece, 2013.
14. **Prata Gomes, D.** and Neves, M., *Reduced bias and threshold choice in the extremal index estimation through resampling techniques*, 11th International Conference of Numerical Analysis and Applied Mathematics 2013: ICNAAM 2013, AIP Conference Proceedings, 1558, 805-808, Rhodes, Greece, 21-27 September 2013.
URL: <http://adsabs.harvard.edu/abs/2013AIPC.1558..805G>
15. **Prata Gomes, D.**, *Challenges in extremal index estimation through computer intensive procedures*, 6th International Conference of the ERCIM Working Group on Computing and Methodological Statistics, Senate House, University of London, UK, 14-31 December 2013.
16. **Lourenço, V.**, *Integrating M-regression with false discovery rates for outlier detection in genetic association studies of quantitative traits*, Joint Statistical Meeting (JSM2013), Montreal, Canada, 2-8 August 2013.
17. **Moreira, E.**, Martins D. S., Pereira L.S. and **Mexia J. T.**, *Assessing drought cycles using a Fourier analysis*, Proceedings of the 1st CIGR Inter-Regional Conference on Land and Water Challenges, Bari, Italy.
18. **Sequeira, I., Moreira, E., Mexia, J. T., Gonçalves, J. and Brás, A.**, *Analysis of HIV integration sites in human chromosomes by genetic and statistical methods*. DGS 2013 – International Conference and Advanced School Planet Earth, Dynamics, Games and Science. Fundação Calouste Gulbenkian e Escola Superior de Economia e Gestão, Universidade Técnica de Lisboa (ISEG-UTL), Lisboa, Portugal, 2 September 2013.

19. **Sequeira, I.**, Gonçalves, J., **Moreira, E.**, **Mexia, J. T.**, Rueff, J. and Brás, A., *Genetic and Statistical Study of HIV Integration in the Human Genome*. 11th International Conference of Numerical Analysis and Applied Mathematics - ICNAAM 2013. Grécia, 21-27 September 2013.

20. V. Rodríguez, E., **Cardoso, R.** and D. Egídio dos Reis, A., *Moments of Dividends and Optimal Expected Dividends in the Erlang(n) dual risk mode*, ASTIN Colloquium, Haia, Netherlands, May 2013.

21. V. Rodríguez, E., **Cardoso, R.** and D. Egídio dos Reis, A., *Some advances on the Erlang(n) dual risk model*, IV Iberian Congress of Actuaries, Barcelona, June 20.

(iii) Organization of thematic sessions in international conferences

1. **Faias, M.**, *Topics in Economics*, 14th Annual Meeting of the Association for Public Economic Theory, Universidade Católica, Lisboa, Portugal, 5-7 July 2013.

2. **Faias, M.**, *Topics in industrial organization*, 13th SAET Conference on Current Trends in Economics, MINES ParisTech, Paris, France, 22-27 July 2013.

3. **Faias, M.**, *Statistics in Environmental and Life Sciences*, International Conference and Advanced School Planet Earth, Dynamic, Games and Science II (DGS II 2013), Calouste Gulbenkian Foundation, Lisbon, Portugal, 2-4 September 2013.

4. **Faias, M.**, *Topics in economic theory and industrial organization*, UECE Lisboa Meetings 2013: Game Theory and Applications, Lisboa, Portugal, 7-9 November 2013.

(iv) Posters

1. **Caeiro, F.**, *A note on the asymptotic comparison of two alternative estimators of a shape second-order parameter*, Symposium on recent advances in extreme value theory honoring Ross Leadbetter, 18 March 2013.

2. **Caeiro, F.**, *Adaptive estimation of a shape second-order parameter*, EVT2013, Vimeiro Portugal, 10 September 2013.

3. **Caeiro, F.**, *aste: An R package for the adaptive estimation the right tail*, R Meeting 2013 Lyon, France, 27-28 June 2013.

4. Capistrano, G., Nunes, C., Ferreira, D., Ferreira, S. S. and **Mexia, J. T.**, *One-way random effects ANOVA with random sample sizes: An application on cancer registries*, 7th Workshop on Statistics, Mathematics and Computation, Polytechnic Institute of Tomar, Tomar, 28-29 May 2013.
5. Ferreira, S. S., Ferreira, D., Nunes, C. and **Mexia, J. T.**, *Aninhamento generalizado e aninhamento ortogonal em modelos mistos*, XXI Congresso da Sociedade Portuguesa de Estatística, Aveiro, Portugal, 29 November-2 December 2013.
6. Penalva, H., **Nunes, S.** and Neves, M., *Statistical Modeling and Inference in Extremes: Applications with R.*, 7th Workshop on Statistics, Mathematics and Computation (WSMC7), Instituto Politécnico de Tomar, Portugal, May 2013.
7. Penalva, H., **Nunes, S.** and Neves, M., *Visualizing and modeling extreme data in R environment*. Workshop EVT2013: Extremes in Vimeiro Today, Vimeiro, Portugal, September 2013.
8. **Prata Gomes, D.**, *Monthly precipitation in the South of Portugal: an extremal spatial analysis*, Workshop EVT-Extremes in Vimeiro Today, Vimeiro, Portugal, 9-11 September 2013.
9. **Prata Gomes, D.**, *Jackknife and Bootstrap together in extremal index estimation*, Symposium on Recent Advances in Extreme Value Theory honoring Ross Leadbetter, Lisboa, 18-20 March 2013.
10. **Santos, C.**, Nunes, C. and **Mexia, J. T.**, *Error orthogonal models: Study of models joining*, 7th Workshop on Statistics, Mathematics and Computation, Polytechnic Institute of Tomar, Tomar, 28-29 May 2013.

6. 4. 6. Other Important Information

(i) Activities

Integrative/multidisciplinary

Miguel Fonseca development of prediction and analysis models for service demand for personal assistance for the ageing and disabled population.

Outreach activities

Marta Faias: invited conference at "Matemática na FCT", Departamento de Matemática, Faculdade de Ciências e Tecnologia, Universidade Nova de Lisboa, 26 November 2013, "Teoria de jogos: a matemática nos modelos económicos, da economia industrial às economias de troca pura".

Miguel Brás de Carvalho: referee of the *Best PhD Thesis Award 2013*, Pontificia Universidad Católica de Chile.

Paulo Canas Rodrigues:

- Co-Chair of the ISI Young Statisticians Committee;
- Chair of the International Scientific Program Committee of the y-BIS 2013: Joint Meeting of Young Business and Industrial Statisticians, sponsored by ENBIS and ISBIS, Istanbul, Turkey, 19-21 September 2013;
- Member of the Local Organizing Committee of the y-BIS 2013: Joint Meeting of Young Business and Industrial Statisticians, sponsored by ENBIS and ISBIS, Istanbul, Turkey, 19-21 September 2013;
- Member of the International Organizing Committee / Scientific Program Committee of the 18th European Young Statisticians Meeting, Osijek, Croatia, 26-30 August 2013;
- Member of the Scientific Program Committee of the Young ISI 2013, Hong Kong, 23-24 August 2013;
- Member of the International Scientific Committee of the 7th Workshop on Statistics, Mathematics and Computation (WSMC7), Tomar, Portugal, 28-29 May 2013.

(ii) Peer-reviewing activities

Filipe Marques:

- Referee for Journal of statistical Theory and Practice and Annals of the Institute of Statistical Mathematics.

Frederico Caeiro:

- Referee:
- AIP Conference Proceedings;
- Bernoulli Journal;
- Communications in Statistics - Simulation and Computation;

- Journal of Statistical Theory and Practice;
- The Canadian Journal of Statistics;
- 2013 Risk Assessment Challenges Book edited by Springer.

Marta Faias:

- Referee for Journal of Mathematical Economics, Journal of Public Economic Theory, Portuguese Economic Journal and Atas IO2013.

Miguel Brás de Carvalho:

- Referee:
 - Bernoulli;
 - Communications in Statistics-Theory and Methods;
 - Computational Statistics and Data Analysis;
 - Extremes;
 - Journal of Applied Probability;
 - Journal of Business Cycle Measurement and Analysis;
 - Journal of Statistical Computation and Simulation;
 - Journal of Statistical Theory and Practice.
- Books: Palgrave Texts in Econometrics;
- Funding: CONYCIT (Chilean NSF).

Paulo Canas Rodrigues:

- Referee for the Deutsche Forschungsgemeinschaft (German Research Foundation).

Rui Rodrigues Cardoso:

- Referee of manuscript entitled "The ruin measures for the compound Poisson risk model with dependence based on a Spearman copula" for the Insurance: Mathematics and Economics.

Vanda Lourenço:

- Referee of a manuscript for Communications in Statistics: Simulation and Computation, 23 January-23 March 2013.

(iii) Supervisions of Ph.D. (2013)

Filipe Marques: co-supervisor of Barbara Regadas Correia in the Doctoral Program in Statistics and Risk Management of Department Mathematics, FCT/UNL, *The multi-sample hyperblock-matrix sphericity test - exact and near-exact distributions for its likelihood ratio test statistic*.

Francisco Carvalho: co-supervisor of Adilson Silva in the Doctoral Program in Statistics and Risk Management of Department Mathematics, FCT/UNL.

Frederico Caeiro: co-supervisor of Ivanilda Cabral (started in 2013).

Miguel Brás de Carvalho: co-supervisor of Daniela Castro, *Multivariate Extremes: Modeling, Smoothing, and Regression*.

(iv) Editing (of journals)

Filipe Marques:

- Special volume of REVSTAT - Statistical Journal, entitled "Business and Industrial Statistics", March 2013, dedicated to the conference: Joint Meeting of yBIS and jSPE;
- Special Volume of the Journal of Statistical Theory and Practice, entitled "Distribution Theory, Estimation and Inference", dedicated to Conference 10th International Conference of Numerical Analysis and Applied Mathematics.

Francisco Carvalho: Editorial board of Journal of Mathematics and Statistics.

Miguel Brás de Carvalho:

- European Young Statisticians, Communications in Statistics-Theory and Methods (Vol. 42, 2013). Eds: Paulo Canas Rodrigues, Miguel de Carvalho;
- *Statistical Models for Diagnosis and ROC Analysis*, *Revstat-Statistical Journal* (Vol. 12, 2014). Guest Editors: Vanda Inácio de Carvalho, Miguel de Carvalho de Carvalho, Wenceslao González Manteiga (Edited in 2013, but published in 2014).

Paulo Canas Rodrigues:

- Co-Editor of the journal Biometrical Letters, the official journal of the Polish Biometric Society (since May 2013);

- Guest Editor of a Special Issue of Communications in Statistics - Theory and Methods (Taylor & Francis) devoted to the 17th European Young Statisticians Meeting (2011-2013);
- Guest Editor of a Special Issue of Communications in Statistics - Simulation and Computation (Taylor & Francis) devoted to the Joint Meeting of y-BIS and jSPE (2012-2014);
- Managing Editor of the journal of Statistics, Optimization and Information Computing (since April 2013; Member of the Editorial Board from February 2013 to March 2013). ISSN: 2310-5070;
- Member of the Editorial Board of the American Journal of Agricultural and Biological Sciences (since July 2011).

Ricardo Covas: Editorial board of Journal of Mathematics and Statistics.

Rui Rodrigues Cardoso: Associate-Editor of European Actuarial Journal.

(v) Editing (of books)

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