

Group Description	
Title of Research Group:	(RG-MATH-LVT-Lisboa-6-948) Order Statistics, Extremes and Applications
Principal Investigator:	MARIA IVETTE LEAL DE CARVALHO GOMES
Main Scientific Domain:	Matemática
Group Host Institution:	Faculdade de Ciências - Universidade de Lisboa

Funding, source, dates
Funding, source, dates
ALL THE REFERRED AMOUNTS INCLUDE OVERHEADS TO PAY FFCUL
1. FCT Base for Research Group Title: (RG-MATH-LVT-Lisboa-6-948) - Order Statistics, Extremes and Applications :
Funding:
corresponding to 2008:
date: 29 Abril 2008 / 22404.26 Eur
date: 26 Novembro 2008 / 24084.57 Eur
Corresponding to 2006:
date: 29 Dezembro 2008 / 19307.25 Eur
2. Projects: The 2 following Projects have Principal Investigators from the Group Title: (RG-MATH-LVT-Lisboa-6-948) - Order Statistics, Extremes and Applications :
FCT/PPCDT/ MAT/58876/2004
“ERAS — EXTREMES, RISK, SAFETY and the ENVIRONMENT”
Principal Investigator: M. Ivette Gomes
Starting: January 1, 2007; Finishing: June 30, 2009
Funding: 14280 Euros.
FCT/ PTDC/MAT/64924/2006
“EXES — SPATIAL EXTREMES”
Principal Investigator: Laurentius de Haan
Starting: July 2007; Finishing: July 2010
Funding: 60000 Euros

Objectives & Achievements
Objectives
Just as before, the main objectives of the team for 2008 were mainly in the field of Statistics of Extremes and applications to Insurance, Finance and Environment, but also in fields as diverse as Reliability, Statistical Quality Control, Robustness and Outliers, where order statistics play a prominent role. Those objectives were essentially related to the following topics:
1. Development of further estimation procedures for parameters of extreme events. The recently developed Minimum-Variance Reduced-Bias (MVRB) estimators of the extreme value index, devised for heavy tails, are expected to play an important role in the estimation of other relevant parameters of extreme events. The same comment applies to the PORT methodology, with PORT standing for Peaks Over Random Threshold.
2. A deeper study of the second and third order structure in statistics of extremes, with the development of new estimators of scale and shape second order parameters, together with the derivation of their asymptotic and finite sample behaviour. Adaptive choice of thresholds in the estimation of parameters of extreme events. Asymptotic comparison at optimal levels.
3. Model testing, under parametric and semi-parametric set-ups, with the development of new test statistics that obey adequate optimality conditions.

Objectives & Achievements

Characterization of max-semi-stable and other non max-stable laws, together with their possible relevance in applications.

4. Exploratory data analysis and extremes, with particular emphasis to the fields of reliability, Poisson regression, statistical quality control, robustness and outliers' identification and proneness.
5. Identification of the extremal and central behaviour of specific univariate and multivariate time series. Solving optimality problems in statistics of extremes. Copula estimation. Spatial extremes and applications.
6. Development of new methods of estimation of parameters of extreme events relevant in the analysis of weakly and strongly dependent structures.

Main Achievements

1. Apart from 5 articles on reduced-bias estimation, and 3 on PORT methods, we refer [P7], a review paper, invited at Extremes, [OI2] and [OI6], which calls for the need of further research on extremes of data under random censoring. See also the preprints CEaul 09 & 11/2008, available at CEaul's website. Additionally, we refer 3 publications (extended abstracts) related with the XV SPE Congress and the 7th World Bernoulli Congress.
2. The main achievements in this topic are related with [OI8] and [ON1]. See also CEaul17/2008. The research developed on adaptive choice of thresholds led to [P12]. We also refer [P13], on an asymptotic comparison at optimal levels of a large set of classical tail index estimators, with emphasis on the mixed moment estimator.
3. On testing issues, we mention the articles [P14], [P17], [OI3] and [OI10]. We also refer 2 papers accepted at the J. Statist. Plan. & Infer. It is also worth mentioning an invited communication at "Jornadas de Classificação e Análise de Dados"
4. As main achievements we refer [P1], [OI5] and [ON3]. See also the preprints, CEaul 01 & 25/2008 (Forensic Statistics), 02/2008 (Robust Control Statistics) 22/2008 (Multivariate Outliers) and 24/2008 (Labor Adjustments). We also refer [ON7] and 6 additional publications (extended abstracts) related with national and international Congresses (WNI 2008, SPE 2008, COMPSTAT 2008 & ISBIS 2008).
5. We refer 3 articles on spatial statistics, 4 articles on multivariate time series, and the sections of [P14] on copula estimation. See also the preprints CEaul 08 & 20/2008. A paper on internet auction markets has been accepted at Extremes and a preprint on stationary max-stable fields is under submission. We also refer 7 additional publications (extended abstracts) related with national and international Congresses (ISF 2008, WNI 2008 and SPE 2008).
6. The main achievements on this item are related with [P6] and [P10]. We also refer [ON5], [ON6] and [ON8], and 5 additional publications (extended abstracts) related with national and international Congresses (RATS 2008, IRMA 2008 and SPE 2008).

Group Productivity

Publications in peer review Journals

Group Productivity

1. Publications in peer review Journals (3000 ca.)

(2403-2846)

- [P1] Amaral Santos, José A. & Neves, M. M. (2008). A Local Maximum Likelihood Estimator for Poisson Regression. *Metrika* 68(3), 257-270.
- [P2] Beirlant, B., Figueiredo, F., Gomes, M.I. & Vandewalle, B. (2008). Improved reduced bias tail index and quantile estimators. *J. Statistical Planning and Inference* 138, 1851-1870.
- [P3] Buishand, A., de Haan, L. & Zhou, C. (2008). On spatial extremes: With application to a rainfall problem. *Ann. Appl. Statist.* 2:2, 624-642.
- [P4] Caeiro, F. & Gomes, M.I. (2008). Minimum-variance reduced-bias tail index and high quantile estimation. *Revstat* 6:1, 1-20.
- [P5] Ferreira, M. & Canto e Castro, L. (2008). Tail and dependence behavior of levels that persist for a fixed period of time. *Extremes* 11:2, 113-133.
- [P6] Ferreira, H. & Pereira, L. (2008). How to compute the extremal index of stationary random fields. *Statistics and Probability Letters*, 78, 1301-1304.
- [P7] Gomes, M.I. Canto e Castro, L., Fraga Alves, M.I. & Pestana, D. (2008). Statistics of extremes for iid data and breakthroughs in the estimation of the extreme value index: Laurens de Haan leading contributions. *Extremes* 11:1, 3-34.
- [P8] Gomes, M.I., Fraga Alves, M.I. & Araújo Santos, P. (2008). PORT Hill and Moment Estimators for Heavy-Tailed Models. *Commun. Statist. — Simul. & Comput.* 37, 1281-1306, 2008.
- [P9] Gomes, M.I., de Haan, L. & Henriques Rodrigues, L. (2008). Tail Index estimation for heavy-tailed models: accommodation of bias in weighted log-excesses. *J. Royal Statistical Society B70, Issue 1*, 31-52.
- [P10] Gomes, M.I., Hall, A. & Miranda, C. (2008). Subsampling techniques and the Jackknife methodology in the estimation of the extremal index. *Comput. Statist. and Data Analysis* 52:4, 2022-2041.
- [P11] Gomes, M.I. & Henriques Rodrigues, L. (2008). Tail index estimation for heavy tails: accommodation of bias in the excesses over a high threshold. *Extremes* 11(3), 303-328.
- [P12] Gomes, M. I., Henriques Rodrigues, L., Vandewalle, B. & Viseu, C. (2008). A Heuristic Adaptive Choice of the Threshold for Bias-Corrected Hill Estimators. *J. Statist. Comput. and Simulation* 78:2, 133-150.
- [P13] Gomes, M.I. & Neves, C. (2008). Asymptotic comparison of the mixed moment and other extreme value index estimators. *Statistics and Probability Letters*, Vol 78:6 pp 643-653, 2008.

Group Productivity

[P14] de Haan, L., Neves, C. & Peng, L. (2008). Parametric tail copula estimation and model testing. *J. Multivariate Analysis* 99:6, 1260-1275.

[P15] de Haan, L. & Zhou, C. (2008). On extreme value analysis of a spatial process. *Revstat* 6:1, 71-81.

[P16] Martins, A., Ferreira, H. & Pereira, L. (2008). Multidimensional outlier-proneness of dependent data and the extremal index. *Statistical Methodology* 5, 72-82.

[P17] Neves, C. & Fraga Alves, M.I. (2008). Testing extreme value conditions — an overview and recent approaches. *Revstat* 6:1, 83-100.

Other publications International

CHAPTERS of BOOKS

[O11] Ferreira, A. (2008). Extreme values in reliability. In Everitt, B. and Melnick, E. (Eds.), *Encyclopedia of Quantitative Risk Analysis and Assessment*, pp. 686-691, John Wiley and Sons, Ltd., Chichester, UK.

[O12] Gomes, M.I., Pestana, D., Henriques-Rodrigues, L. & Viseu, C. (2008). Tail Behaviour: an Empirical Study. In Arnold, B.C., Balakrishnan, N., Sarabia, J.M. and Mínguez, R. (eds.), *Advances in Mathematical and Statistical Modeling*, Chapter 14, 195-207. ISBN 978-0-8176-4625-7, DOI: 10.1007/978-0-8176-4626-4_14, Birkhauser, Bóston

[O13] Neves, C. & Fraga Alves, M.I. (2008). Ratio of Maximum to the Sum for Testing Super Heavy Tails. In Arnold, B.C., Balakrishnan, N., Sarabia, J.M. and Mínguez, R. (eds.), *Advances in Mathematical and Statistical Modeling*, Chapter 13, 181-194. ISBN 978-0-8176-4625-7, DOI: 10.1007/978-0-8176-4626-4_14, Birkhauser, Boston.

PROCEEDINGS

[O14] Cordeiro, G. & Neves, M. (2008). Bootstrap and exponential smoothing working together in forecasting time series. *Proceedings in Computational Statistics (COMPSTAT 2008)*, Paula Brito (Ed.), 891-899. Physica-Verlag.

[O15] Gomes, D., Nunes, C. & Canto e Castro, L. (2008). Cold and heat waves: modeling mortality in Évora-Portugal. In H.C. Eilers (ed.), *Statistical Modelling*, 250-255, North-Holand.

[O16] Gomes, M.I. (2008). Statistics of extremes under censoring schemes. In Molina, M. et al. (eds.), *II Iberian Mathematical Meeting*, 53-54, Universidad Extremadura editions.

[O17] Gomes, M.I. (speaker) & Henriques Rodrigues, L. (2008). PORT-ML, PORT-MP and other Classical Tail Index Estimators: Asymptotic Comparison at Optimal Levels. In Zaiats, V. ed., *BAS 2008*, 67-69, CRM editions.

[O18] Gomes, M.I., Henriques Rodrigues, L., Pereira, H. & Pestana, D. (2008). A semi-parametric estimator of a “scale” second order parameter based upon the log-excesses. In Luzar-Stiffler, V., Dobric, V.H. and Bekic, Z. (eds.) *ITI 2008 Proceedings*, ISBN 978-953-7138-12-7, pp. 329-334, 2008.

[O19] Henriques Rodrigues, L. (speaker) & Gomes, M.I. High Quantile Estimation and the PORT Methodology. In Zaiats, V. ed., *BAS 2008*, 73-74, CRM editions.

[O110] Neves, C. & Pereira, A. (2008). Discerning between light tailed distributions with finite or infinite right endpoint, IASC2008, the Joint Meeting of 4th World Conference of the IASC and 6th Conference of the Asian Regional Section of the IASC on Computational Statistics & Data Analysis (Electronic Publication, 9 pp), Yokohama, Japan, 2008.

Other publications National

PROCEEDINGS

[ON1] Caeiro, F. & Gomes, M.I. (2008). Caudas pesadas: t de Student e variantes assimétricas versus metodologia semi-paramétrica. In Hill, M.M., Ferreira, M.A., Dias, J.G., Salgueiro, M.F., Carvalho, H., Vicente, P. E Braumann, C. (eds.), *Estatística: da Teoria à Prática (Actas XV Congresso Anual da SPE)*, 127-136, 2008.

[ON2] Ferreira, M. & Canto e Castro, L. (2008). Distribuição estacionária e comportamento extremal de um processo RARMAXp. In Hill, M.M., Ferreira, M.A., Dias, J.G., Salgueiro, M.F., Carvalho, H., Vicente, P. E Braumann, C. (eds.), *Estatística: da Teoria à Prática (Actas XV Congresso Anual da SPE)*, 203-214, 2008.

[ON3] Figueiredo, F. & Gomes, M.I. (2008). Monitorização de um processo de produção de rolhas — comparação da performance das cartas de controlo tradicionais com a de cartas robustas. In Hill, M.M. et al. (eds.), *Estatística: da Teoria à Prática (Actas XV Congresso Anual da SPE)*, 245-258, 2008.

[ON4] Henriques-Rodrigues, L. (2008). Estimação do índice de cauda em modelos de caudas pesadas acomodação do vies nos excessos acima de um “threshold” elevado. In Hill, M.M. et al. (eds.), *Estatística: da Teoria à Prática (Actas XV Congresso Anual da SPE)*, 45-69 (Prémio SPE), Edição SPE.

[ON5] Martins, A.P. (2008). O coeficiente de dependência extremal de uma distribuição multivariada de valores extremos. In Hill, M.M., Ferreira, M.A., Dias, J.G., Salgueiro, M.F., Carvalho, H., Vicente, P. E Braumann, C. (eds.), *Estatística: da Teoria à Prática (Actas XV Congresso Anual da SPE)*, 315-322, 2008.

[ON6] Pereira, L. (2008). Estudo do comportamento do máximo do campo gaussiano periódico. In Hill, M.M., Ferreira, M.A., Dias, J.G., Salgueiro, M.F., Carvalho, H., Vicente, P. E Braumann, C. (eds.), *Estatística: da Teoria à Prática (Actas XV Congresso Anual da SPE)*, 415-424, 2008.

[ON7] Suleman, A., Reis, E. & Gomes, M.I. (2008). Estimação multinomial: uma nova proposta pseudo-Bayesiana. In Hill, M.M. et al. (eds.), *Estatística: da Teoria à Prática (Actas XV Congresso Anual da SPE)*, 549-560, 2008.

[ON8] Temido, M.G. (2008). Sobre o máximo de campos aleatórios bivariados normais fortemente dependentes. In Hill, M.M., Ferreira, M.A., Dias, J.G., Salgueiro, M.F., Carvalho, H., Vicente, P. E Braumann, C. (eds.), *Estatística: da Teoria à Prática (Actas XV Congresso Anual da SPE)*, 571-581, 2008.

Master and Ph.D. thesis completed

Ph. D. Thesis:

[PhD1] Ferreira, Marta. “Extremos em Séries Temporais Max-Autoregressivas”. Universidade de Lisboa.

Group Productivity

Local: Universidade de Lisboa

Orientador: L. Canto e Castro.

[PhD2] Prata Gomes, Dora “Métodos Computacionais na Estimação Pontual e Intervalar do Índice Extremal”.

Local: Universidade Nova de Lisboa

Orientadores: M. M. Neves e J. Tiago Mexia.

[PhD3] Zhou, Chen. “On Extreme Value Statistics”.

Local: Erasmus University Rotterdam.

Orientadores: Casper de Vries & Laurens de Haan.

M. Sc. Thesis:

[MSc1] Conceição, Sandra, “Modelos de Mutação em Microssatélites e Inferência Filogenética”. Universidade de Lisboa.

Orientador: L. Canto e Castro.

[MSc2] Cunha, Luísa, “Modelos Rasch e escalas de Likert e Thurstone na Medição de Atitudes”. Universidade de Lisboa.

Orientador: L. Canto e Castro.

[MSc3] Farias, Inês Alves, “Risco da Exposição Humana aos Contaminantes na Alimentação: o Cádmi e o Chumbo no Peixe-Espada Preto”, DEIO, FCUL, 2008.

Orientador: M. Isabel Fraga Alves.

[MSc4] Garcia, Ana Subtil Freitas, “Significância Estatística em Testes de Hipóteses Simultâneos: uma Abordagem Envolvendo Modelos de Mistura”. Universidade de Lisboa.

Orientador: L. Canto e Castro.

[MSc5] Gonçalves, Inês Filipa Barata, “Estimação da Probabilidade de Ocorrência de Acontecimentos Raros em Contextos Multivariados”. Universidade de Lisboa.

Orientador: L. Canto e Castro.

[MSc6] Pereira Sampaio, T.S. “Aplicação de Modelos Mistos em Ensaios Genéticos Florestais”, Mestrado em Matemática Aplicada às Ciências Biológicas”.

Orientador: M.M. Neves.

[MSc7] Soares, Marta, “Stochastic processes in Cost-effectiveness analysis in Health Care”. Universidade de Lisboa.

Orientador: L. Canto e Castro.

[MSc8] Vilares, Íris, “Interaction between microorganisms and the Innate and Adaptive Immune System: a mathematical view”, Mestrado em Matemática Aplicada às Ciências Biológicas.

Orientadores: J. Carneiro and M.M. Neves.

Organization of conferences

1. “SPE/CIM Afternoon on Statistical Extremes”, Coimbra, Fevereiro 15, 2008.

Invited Speakers and Discussants: L. Pereira (DM-UBI), M.I. Gomes (DEIO-FCUL), J. Hüsler (Bern University), A. Ferreira (ISA-UTL) and L. de Haan (Erasmus University Rotterdam).

Organizer: Luísa Canto e Castro

<http://eu.wiley.com/WileyCDA/WileyTitle/productCd-0470035498.html>

2. “XV Jornadas de Classificação e Análise de Dados”, 27-29 de Março de 2008, Setúbal

M.M. Neves was a member of the Scientific Committee and organized a thematic session on “Extremes and Applications”.

3. “A Matemática nas Ciências Biológicas”, ISA, July 14.

Invited Speakers: Jorge Carneiro (IGC), Henrique Cabral (FCUL) & Antero Martins (ISA)

Organizer: M.M. Neves.

4. “III Workshop on Statistics, Mathematics and Computation” (jointly with the “I Luso-Polish Workshop on Biometry”, Lisboa, 21-22 July, 2008.

Members of this Group in the Scientific Committee: M.I. Gomes & M.M. Neves.

5. “COMPSTAT 2008”, August 24-29, Porto.

L. Canto e Castro & F.O. Figueiredo were members of the Local Organizing Committee. Website still available at: <http://www.fep.up.pt/compstato8/>.

6. “XVI Congresso da Sociedade Portuguesa de Estatística”, Vila Real, 1-4 October.

Sandra Dias was a member of the Local Organizing Committee.

Group Productivity

7. “A Matemática nas Ciências Biológicas”, ISA, October 28.

Invited Speakers: A. Murta (IPIMAR), J.M. Pereira (ISA), D. Pestana (FCUL)

Organizer: M.M. Neves.

8. “VI Conferência Estatística e Qualidade na Saúde”, Lisboa, Escola Superior de Tecnologia da Saúde de Lisboa, November 20-21, 2008.

M.M. Neves was a member of the Scientific Committee.

9. “6th Conference on Extreme Value Analysis — Probabilistic and Statistical Models and their Applications (EVA 2009)”, Fort-Collins, Colorado, July, 22-26, 2009. M.I. Gomes is a member of the Scientific Committee and organizer of a Thematic Session on “Statistics of Extremal Events”.

Industry contract research

Despite of a few contacts with the Portuguese Institute of Quality (“Instituto Português da Qualidade”) and Auto-Europa to try introducing in the industry the recent developed robust methods in Statistical Process Control, there was not yet any formal contract.

Internationalization

Most of the members of this team have kept deep international contacts and are well-recognized internationally not only in the area of statistics of extremes, but also in the areas of spatial, environmental and financial statistics, risk assessment theory and statistical quality control. In 2008 there was collaborative publication with J. Beirlant, T. Buishand, Z. Kabluchko, M. Schlather, L. Peng, B. Vandewalle, C. de Vries and C. Zhou. The organization of the 56th Session of the ISI, in Lisbon, with a strong collaboration of several members of this team, helped Portugal to become well-known internationally in the whole area of Statistics. This internationalization was partially responsible for the number of invited lectures in 2008, either national or international: Ana Ferreira (SPE/CIM Afternoon) Fernanda Figueiredo (ISBIS 2008); M. Isabel Fraga Alves (IPS/ESCE; UIMA), M. Ivette Gomes (SPE/CIM Afternoon; FMH-UTL; II Iberian Mathematical Meeting); Laurens de Haan (Georgia Tech; SAMSI; SPE/CIM; Bern University; University of Göttingen); Lígia Henriques-Rodrigues (UBI); Manuela Neves (ENSPM 2008; SPE 2008). We also would like to emphasize the strong co-operation with researchers in the Erasmus School of Economics, Erasmus University Rotterdam and the Tinbergen Institute, where L. de Haan finished at 2008 the supervision of the Ph.D. thesis of C. Zhou. The research contacts with the Katholieke Universiteit Leuven, have also become stronger in recent years, as can be inferred from papers written jointly with Jan Beirlant and Bjorn Vandewalle, a CEAUL Post-Doc student in 2005-2007. Strong research contacts have also been kept with T.A. Buishand (Royal Netherlands Meteorological Institute), Dejuan Li (now at Fundan University, China), Holger Drees (Saarland University, Germany), Jan Picek (Liberec University, Check Republic), a CEAUL Post-Doc student in 2003-2004, Jap Geluk (The Petroleum Institute, United Arab Emirates), John Einmahl (Tilburg University, The Netherlands), Jurg Husler (Bern University, Switzerland) and Liang Peng (Georgia Polytechnical Institute, USA), among others.

Future Research

Objectives

1.Objectives (3000 ca.)

(2431-2857)

The main objectives during the nearby future are again in the field of statistics of univariate, multivariate, multidimensional and spatial extremes, with special emphasis on their applications to Life Sciences, Environment, Risk, Insurance, Finance and Statistical Quality Control. Among the topics to be dealt with, we mention:

- 1) Adaptive estimation of univariate and multivariate parameters of extreme events. Computer-intensive methods, like the bootstrap, will be the basis of new methodologies of adaptive choice of thresholds mainly for second-order reduced-bias, now involving, with a high probability, the third-order behaviour of the underlying models.
- 2) Due to the importance of random censored data in Life Sciences and Survival Analysis, one of the topics to be considered under this Research Group, we feel the need to develop adequate methodology in the area of extreme values, related with this type of data.
- 2) Establishment of a link among recent developed methodologies, like the PORT methodology, with PORT standing for Peaks Over Random Thesholds, the MVRB, with MVRB standing for Minimum-Variance Reduced-Bias, generalized KERNEL and PWM methodologies, with PWM standing for Probability Weighted Moments.
- 3) Development of new estimators of the endpoint of the underlying model, whenever finite and either univariate or multivariate. This is an extremely important parameter in the analysis of athletic events, related with the value of the ultimate world record, but also in all areas where tails are light or of an exponential type.
- 4) Other important parameters under consideration will be the Value-at-Risk at any level p , the size of the loss occurred with small probability p , the adjustment coefficient, a rudimentary measure of risk in a collective of insurance risks, and the Weibull tail coefficient, the regular variation coefficient of the inverse failure rate function.
- 5) In all the developed estimation procedures, we intend to consider, additionally to independent, identically underlying structures, diversified weak dependent structures as well as positively (or negatively) associated sequences of random variables. For dependent frameworks, we shall try to improve the estimation of the extremal index, of the pre-asymptotic extremal index and of the coefficient of asymptotic tail dependence.
- 6) Development of a new methodology for assessing the adjustment of pRRARMAX (power Random Autoregressive for Maxima) processes to real data in the fields of finance, environment and biology. Inference for extremes of specific max-autoregressive processes, including the pRRARMAX, will be thus one of the topics under consideration.
- 7) All the new methodologies will be applied not only to simulated data but also to real data in the above mentioned areas, and some of them will be devised for

Future Research

the analysis of spatial data.

Funding, source, dates

ALL THE REFERRED AMOUNTS INCLUDE OVERHEADS TO PAY FFCUL

1. FCT Base for Research Group Title: (RG-MATH-LVT-Lisboa-6-948) - Order Statistics, Extremes and Applications :

A. Funding left to 2009 from 2008:

Due to the delay and late transferring dates from FCT (at the end of the year), the Group was not able to schedule a convenient execution of a percentage from the budget of previous year, namely: around 56315.54 Eur.

B. Funding from 2009:

Already transferred the first semester amount from FCT on the 3rd April 2009: 26.943.00 Eur

Expected Second semester amount from FCT : similar to first semester

2. Projects: Partially source funding is still available during 2009 and 2010:

FCT/PPCDT/ MAT/58876/2004

“ERAS — EXTREMES, RISK, SAFETY and the ENVIRONMENT”

Principal Investigator: M. Ivette Gomes

Starting: January 1, 2007; Finishing: June 30, 2009

Funding: 14,280 Euros.

FCT/ PTDC/MAT/64924/2006

“EXES — SPATIAL EXTREMES”

Principal Investigator: Laurentius de Haan

Starting: July 2007; Finishing: July 2010

Funding: 60,000 Euros

Apart from this, members of this Research Group have submitted to FCT the following application:

FCT/PTDC/MAT/101736/2008

Title: “EXTREMA: Statistics of Extremes in Today's World”

Principal Investigator: M. Ivette Gomes

Other responsible researchers: Luísa Canto e Castro, M. Isabel Fraga Alves and M. Manuela Neves,

Budget: 96,720 Euros