

Fundação para a Ciência e a Tecnologia

Evaluation Research Unit 2017/2018

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Part 1: Identification of the R&D Unit, the Management Institutions and the Participant Institutions

01. IDENTIFICATION OF THE R&D Unit

1.0 Reference

6

1.1 Name of the R&D Unit

Centre of Statistics and its Applications

1.2 Acronym

CEAUL

1.3 Coordinator

Lisete Maria Ribeiro de Sousa

1.4 Scientific areas

Exact and Natural Sciences - Mathematics

1.5 Keywords

Bayesian Analysis

Biostatistics

Parametric and Semiparametric Inference

Statistical Modelling and Data Analysis

Space Time Models

Extreme Value Theory

1.6 R&D Unit Contacts and Address

Postal Address:

CEAUL, Faculdade de Ciências da Universidade de Lisboa, Bloco C6 - Piso 4, Campo Grande
1749 - 016 Lisboa

Nº de telefone:217500120

Endereço e-mail:ceaul@ciencias.ulisboa.pt

1.7 Link to the R&D Unit's page on the Internet

<http://www.ceaul.fc.ul.pt/>

02. Evaluation Panel to whom the R&D Unit submits the current application

2.1 Evaluation Panel to whom the R&D Unit submits the current application

EXACT SCIENCES - Mathematics

03. Involved institutions

3.1 Main Management Institution

FCiências.ID - Associação para a Investigação e Desenvolvimento de Ciências (Fciências.ID)

3.2 Other(s) Management Institution(s)

3.3 Partnership agreements with Management Institution(s)

3.4 Participating Institution(s)

3.5 Partnership agreements with Participant Institution(s)

Institution Name

[Instituto Politécnico de Leiria \(IPLeiria\)](#)

[Instituto Politécnico de Lisboa \(IPL\)](#)

[Instituto Superior de Engenharia de Lisboa \(ISEL/IPL\)](#)

[Instituto Politécnico de Santarém \(IPSantarém\)](#)

[Instituto Politécnico de Setúbal \(IPSetúbal\)](#)

[Instituto Superior de Engenharia do Porto \(ISEP/IPP\)](#)

[Universidade Aberta \(UAberta\)](#)

[Universidade da Madeira \(UMA\)](#)

[Universidade do Algarve \(UAlg\)](#)

[Faculdade de Ciências da Universidade de Lisboa \(FC/ULisboa\)](#)

[Universidade dos Açores \(UAçores\)](#)

[Faculdade de Medicina Dentária da Universidade de Lisboa \(FMD/ULisboa\)](#)

[Faculdade de Economia da Universidade do Porto \(FEP/UP\)](#)

[Instituto Superior de Agronomia \(ISA/ULisboa\)](#)

[Instituto Superior Técnico \(IST/ULisboa\)](#)

[Instituto Português do Mar e da Atmosfera, I. P. \(IPMA\)](#)

04. Description of the main contributions of the team of Integrated Researchers in the current application

4.1 General description of the R&D Unit

The Centre of Statistics and its Applications (CEAUL), University of Lisbon, occupies a central and unique role in Portugal, emerging as the only centre with Statistics as its core research area. Its contributions have covered not only many aspects of fundamental statistics and probability. The interdisciplinary nature of the contributions of its members is well expressed by the broad range of application areas its researchers have been involved with, including areas like Health, Life Sciences, Forest Fires, Ecology, Fisheries, Quality Control, Insurance and Financial Risk, Education, and natural hazards in Geophysics and Environment. CEAUL's team currently includes two groups, according to their research and scientific interests: Order Statistics, Extremes, Modelling and Simulation; and Statistical Models and Methods for Complex Systems. Members of both groups share interests in Applied Probability, Statistical Inference, Probability Modelling and Data Analysis. These groups were led by senior researchers who defined the activities of each group, both providing coherence to the group and encouraging the interaction between groups in their activities, in common research themes, as well as in the organization of advanced courses, conferences and seminars. Together with the Coordinator, group leaders were the core of the scientific panel whose responsibility was to define and monitor the main goals of the research unit and to manage and allocate the available resources.

Fundamental and applied research will continue being carried out by CEAUL members in several areas such as: Statistics of Extremes, Computational Statistics and Simulation, Resampling Methodologies, Quality Control, Bayesian Statistics, Biostatistics, Environmental and Ecological Statistics, Statistics in Genomics, Statistics in Medicine, Longitudinal Models and Survival Analysis, Time Series Analysis, Categorical Data Analysis and Missing Data, Sampling, Principal Component Analysis, Classification Methods, Temporal and Spatial Statistics, Design of Experiments and History and Teaching of Statistics.

The research and activities will continue being developed always keeping in mind the objectives and main goals of CEAUL: to pursue the development of theoretical and methodological research; to collaborate with researchers from different core areas which might have practical problems requiring applications of standard methods or the development of new ones; to promote the correct use of Statistics in Academia and Society in general; to provide statistical consulting services to companies and institutions. The members will continue the efforts to publish the results of their research in mainstream high quality journals in each field and presenting them to the scientific community in well-recognized international meetings. Visibility at international level is also an important goal for CEAUL. For that purpose it is the objective of CEAUL to keep promoting international collaboration, particularly among younger members, seeking the involvement in European projects, participation in international events, and encouraging visits of short to medium term in internationally recognized Centres of Research.

CEAUL has strong links and cooperates with the National Institute of Statistics (INE), the Portuguese Statistical Society (SPE), the Portuguese Mathematical Society (SPM) and the Centre of International Mathematics (CIM). Most of its members belong to Universities and Polytechnics Institutes, with which partnership agreements were established, except for three institutions (CGD considered no need for an agreement, NOVA Medical School did not answer to our request, and IHMT-NOVA did not accept to write an agreement).

CEAUL will continue to provide editorial support, mostly through some of its senior members, to REVSTAT - Statistical Journal, an International Journal in the area of Probability and Statistics in English, edited by INE.

4.2 Identification and brief description of up to 5 contributions the R&D Unit considers most important of those provided in period 2013-2017 by Integrated Researchers registered in the current application, independently of the R&D Unit having existed or not

CEAUL has a surprisingly wide range of contributions in many areas. Here we decided to choose four of not only national but global impact. We added to that a fifth contribution representing a recent development for CEAUL, but which we see as a challenge and opportunity for the future, as described below.

In the field of EVT there has been an active contribution in the development of general consistent and admissible pioneering estimators for the right endpoint of both light and exponential tails, with an application to modelling supercentenarian women's records, among others. High quantiles and other parameters of extreme events have also been studied and applied under innovative frameworks: first, on the basis of the weak convergence of a weighted sequential tail empirical process, classical EVT was extended to non-identically distributed observations, and performed on the basis of the non-parametric estimation of the proportionality function for tails. New tests were developed for this function and for the validity of the heteroscedastic model, together with an application to stock market returns; secondly, a formal and innovative test for truncation was proposed, enlarging the possibilities of extreme value modelling using Pareto tails, and offering an alternative scenario by adding a truncation point T that is large with respect to the available data. Essentially on the basis of pseudo maximum likelihood (ML) approaches, estimators of parameters of extreme events were proposed and studied both under truncated and non-truncated Pareto-type and also exponential-type distributions. This work was motivated by practical examples from different fields, among which we mention earthquake analysis, hydrology and diamond valuation. The procedures and methodologies developed have been partially published and enhanced the position of the CEAUL's contribution to the international EVT community, by opening new lines of research in the field.

The CEAUL members doing research in Environmental Statistics have been collaborating with researchers from Research Forest Centre (CEF) and Instituto D. Luiz (IDL, a Research Center devoted to Geosciences) in many different aspects of vegetation fire management. The output includes many publications in international journals, annual fire risk maps reporting spatial variation of ignition probability, spatial variation of extreme fire risk, etc. Spatial temporal Bayesian hierarchical modelling was basically the methodological approach used in the analyses. Recent tragic events that took place in Portugal during 2017 once again showed the importance of fire risk management. At the request of a recently formed government commission to overlook the management of wildfires in Portugal, the group was invited, jointly with CEF, to produce annual fire risk maps at a very high resolution (2 km grid cells). Further, the effort of this Unit on this field is recognized internationally with the invitation to write the chapter on wildfire risk management in the coming handbook of Environmental and Ecological Statistics.

In the field of Ecological Statistics, CEAUL has been involved in methodological developments and practical applications, mostly in the area of wildlife population size estimation, namely using distance sampling and spatially explicit capture recapture procedures. These are key methods in monitoring efforts under the sustainable development framework required in a world with ever increasing threats to wildlife. Especially significant contributions to the field include the development of density estimation techniques from passive acoustic monitoring data, which in the last 10 years have been led worldwide by our members and close collaborators, in close articulation with the University of St Andrews, with whom there is a privileged link. Outputs include the first passive acoustic density estimation exercise of a cetacean species, and a review paper on passive acoustic animal density estimation, which is currently widely used as the basis for further studies. These and derived methods are being routinely used by the US Navy to monitor cetacean populations of interest. The members of this project have been interacting with multiple governmental agencies and universities all over the world, having had significant impacts in the monitoring of several wildlife populations, including for example Polar Bears in the Arctic, with current and past work involving all 5 polar bear nations (Canada, Norway, Russia, Denmark and United States), as well as several endangered species, e.g. Gopher tortoises in Utah, right whales

in the Bering Sea, gibbons in Cambodia or Chimpanzees in Guinea Bissau.

According to the current guidelines of the World Health Organization, estimation of sero-epidemiological measures is crucial to inform malaria control and surveillance of populations on the path to disease elimination. However, such statistical task requires to design epidemiological studies with large enough sample size to ensure high estimation precision and/or power to detect changes of malaria transmission intensity after a given malaria control intervention. The main contribution of this line of research involves a series of methodological investigations on this topic in collaboration with researchers from the London School of Hygiene and Tropical Medicine. Simulation was used to derive sample sizes for cross-sectional surveys in detecting changes in seroconversion rate (one of the key sero-epidemiological measures) with high power. The impact of this research has already reached six malaria field studies in Iran, Vanuatu, Gambia, Sri Lanka and Tanzania, and trachoma, in Gambia. It is expected that the impact will continue to rise due to the increasing number of countries worldwide close to malaria elimination - this contribution was partially published in *Malaria Journal* (2015).

Besides these 4 areas with a strong past record for CEAUL, a recent field with contributions by CEAUL members which we will continue to expand is Machine Learning. Automated classification systems in a Big Data era requires new statistical models, tools and methods. This is a challenge where an active contribution has been given by members of CEAUL. Machine Learning techniques are presently viewed as good alternatives, with artificial neural networks (ANNs) often used in this context. However, ANNs represent black boxes and the lack of interpretability of the results is a serious drawback. Research in this area has already been undertaken by CEAUL, and changes to the Generalized Additive Neural Networks, to improve flexibility and interpretability of the results, have already been proposed (one paper published in 2017 and one submitted in the beginning of 2018). Such ANNs now have the potential of being used more often and in a wider range of research areas, namely in medical research. This line of research will be pursued by the group.

4.3 Main publications in 2013-2017 authored by Integrated Researchers registered in the current application

Reference	URL
Beirlant, J., Fraga Alves, M.I. and Gomes, M.I. (2016). Tail fitting for truncated and non-truncated Pareto-type distributions. <i>Extremes</i> , 19 (3), 429-462.	
Castagliola, P., Maravelakis, P.E. and Figueiredo, F.O. (2016). EWMA Median Chart with Estimated Parameters IIE Transactions, 48, 66-74.	
Einmahl, J.H.J., de Haan, L. and Zhou, C. (2016). Statistics of heteroscedastic extremes. <i>Journal of the Royal Statistical Society, Series B</i> , 78, 31-51.	
Guindani, M., Sepúlveda, N., Paulino, C.D. and Müller, P. (2014). A Bayesian semi-parametric approach for the differential analysis of sequence counts data. <i>J. Royal Statistical Society C (Appl. Statist.)</i> , 63 (3), 385-404.	
Marques, T.A., Thomas, L., Martin, S.W., Mellinger, D.K., Ward, J.A., Moretti, D.J., Harris, D. and Tyack, P.L. (2013). Estimating animal population density using passive acoustics. <i>Biological Reviews</i> , 88, 287-309.	
Martins, R., Silva, G.L. and Andreozzi, V. (2016). Bayesian joint modeling of longitudinal and spatial survival AIDS data. <i>Statistics in Medicine</i> , 35, 3368-3384.	
Papoila, A.L., Riebler, A., Amaral Turkman, M.A., São João, R., Ribeiro, C., Geraldes, C. and Miranda, A. (2014) Stomach cancer incidence in Southern Portugal 1998-2006: a spatio-temporal analysis. <i>Biometrical Journal</i> , 56 (3), 403-15.	
Pereira, L.S., Paredes, P., Rodrigues, G.C. and Neves, M.M. (2015). Modeling malt barley water use and evapotranspiration partitioning in two contrasting rainfall years. <i>Assessing AquaCrop and SIMDualKc models. Agricultural Water Management</i> , 159, 239-254. (Corrigendum in <i>Agric. Water Manage.</i> 163, pp 408).	
Silva-Fortes, C., Freitas, A., Roque, S. and Sousa, L. (2015). Arrow Plot and CA Maps for Visualizing the Effects of Background Correction and Normalization Methods on Microarray Data. In <i>Pattern Recognition in Computational Molecular Biology: technologies and approaches</i> , M. Elloumi et al., Editors, John Wiley & Sons. pp. 394-416.	
Turkman, K.F., Scotto, M.G. and de Zea Bermudez, P. (2014). <i>Non-linear Time Series: Extreme Events and Integer Value Problems</i> . Springer.	

4.4 Description of other relevant contributions resulting from the activities in 2013-2017 of Integrated Researchers registered in the current application

Some members of CEAUL integrated research teams of international projects, such as: 1) Project financed by the European League Against Rheumatism (EULAR), Patient self-reported quality of osteoarthritis care - comparing cross-national data from Denmark, UK, Portugal and Norway; 2) Strengthening International Cooperation of the Klimatext Research Team; 3) COST Action IC1408 on Computationally-intensive methods for the robust analysis of non-standard data; 4) FP7 European project PERSSILAA on PERSONALISED ICT Supported Service for Independent Living and Active Ageing (under this project CEAUL team awarded a

one-year grant for a MSc student to initiate her in scientific research); 5) European Network for Model-driven Investigation of Environmental Processes (Portugal, Spain, Italy, UK); 6) Open Tools for Analysis of Spatial Data in Life Sciences, Erasmus+ 2015-1-BE01-KA204-013222; 7) UPHI-STAT project (FCT), coordinated by a CEAUL member, to explore the relationship between urban planning and health inequities, in the city of Praia, Cape Verde. CEAUL members were involved in other international/national projects discriminated in the Units' annual scientific reports.

Additionally, international recognition is still well manifested particularly through 1) publications with international researchers; 2) invitations to give talks in International Conferences and to organize thematic sessions; 3) invitations to present seminars in international institutions; 4) participation as associated editors of international periodicals; 5) members of international scientific committees.

CEAUL integrates BIostatNET, an interdisciplinary Biostatistics network, and PT-MATHS-IN, a member of an international network with projects on Health, Energy and Water Networks, and Logistic-Traffic Models.

CEAUL integrated members supervised 34 students that finished their PhD during 2013-17, as well as 94 MSc dissertations. Ten advanced courses, mainly on emerging areas of statistics, were organized directly by CEAUL, some of them lectured by CEAUL members. As part of the advanced training, CEAUL holds regular seminars on diverse areas of Statistics. Eighty three seminars were organized, 48 of them by international researchers. Also 17 International Scientific Meetings were organized, the last being on the emerging field of Big Data.

In the medical area, there was collaboration with many researchers. We highlight the Institute of Molecular Medicine and the Clinical Centre of the Champalimaud Foundation. A member of CEAUL gave statistical support to the Research Unit of Centro Hospitalar de Lisboa Central (aggregating 6 hospitals) as co-head of the Epidemiology and Statistics Consulting Core. Consulting services were provided for Novartis Pharmaceuticals and for the Portuguese Association for Hospital Development. Other consultancy activities include AMORIM & IRMÃOS SA, Amorim Florestal and PROSEGUR. Jointly with IPMA and IDL consulting was done for EDP regarding the influence of weather in the disruption of electricity.

CEAUL maintained activities to promote Statistics in the wider Society. As an example, the project Ciência nos Pátios, included in the program Ciência Viva, allowed the transfer of basic knowledge on exploratory data analysis to very young students (age 7-9). At secondary school, with the aim of sensitising older students (age 15-18) towards a statistical future, two CEAUL members have organized the sessions AEVAE: A Estatística Vai à Escola.

CEAUL has been active in disseminating the methods that does research on; creating software that implements methods is perhaps one of the most effective ways of doing so. Several CEAUL members have developed R-packages: evt0: Mean of order p, peaks over random threshold Hill and high quantile estimates; ACD: Categorical data analysis with complete or missing responses; bild: Binary Longitudinal Data; subselect: Selecting Variable Subsets; cold: Count Longitudinal Data; Boot.EXPOS: Forecasting Time Series.

Part 2: Description of the R&D Unit, main contributions of the team of integrated researchers in the application and funding in 2013-17

05. Reports and membership of External Advisory Board

5.1 External Advisory Board reports in 2013-2017

R&D Unit File

CEAUL - Centre of Statistics and its Applications [Advisory Board Report CEAUL_2017.pdf](#)

CEAUL - Centre of Statistics and its Applications [Advisory Board Report CEAUL_2013-16.pdf](#)

5.2 Current External Advisory Board membership

R&D Unit Member Name Institution

CEAUL Henrique Cabral Faculdade de Ciências da Universidade de Lisboa - Portugal

CEAUL Juerg Huesler Institute of Mathematical Statistics and Actuarial Science - Switzerland

CEAUL Philippe Castagliola Université de Nantes - France

CEAUL Len Thomas University of St. Andrews - Scotland

5.3 External Advisory Board membership

Member Name Institution

Henrique Cabral Faculdade de Ciências da Universidade de Lisboa - Portugal

Juerg Huesler Institute of Mathematical Statistics and Actuarial Science - Switzerland

Philippe Castagliola Université de Nantes - France

Len Thomas University of St. Andrews - Scotland

06. Funding in 2013-2017

6.1 Annual funding in 2013-2017

	FUNDING SOURCES (TOTAL FUNDING)					2013	2014	2015	2016	2017	TOTAL (K€)
Fundação para a Ciência e a Tecnologia, I.P. - FCT						200	146	23	98	156	623
R&D Unit Pluriannual funding						125	119	7	82	141	474
Project funding						75	16	0	0	0	91
Funding for contracts of researchers with PhD (1)						0	0	0	0	0	0
Funding for PhD, PostDoc or other fellowships (2)						0	11	15	15	15	56
Other funding						0	0	1	1	0	2
Other national sources						3	19	18	14	4	58
Funding received from Participant or Management Institutions						0	0	0	0	0	0
Public sources (3)						1	5	3	0	0	9
Companies, industry and other private sources based in Portugal (3)						0	13	15	12	0	40
Any other funding source (3)						2	1	0	2	4	9
Total (K€)						203	165	41	112	160	681

FUNDING SOURCES (TOTAL FUNDING)	2013	2014	2015	2016	2017	TOTAL (K€)
International sources	0	0	0	0	0	0
European Commission (3)	0	0	0	0	0	0
Companies, industry and other private sources not based in Portugal (3)	0	0	0	0	0	0
Other funding sources (3)	0	0	0	0	0	0
Total (K€)	203	165	41	112	160	681

(1) Payed through an institution or directly to researchers with PhD integrated in the R&D Unit

(2) Payed directly to fellows, researchers or students integrated in the R&D Unit

(3) Grants, projects, fellowships, prizes received, etc

07. Integrated Researchers, PhD students and research contracts in 2013-2017

7.1 Total numbers of Integrated Researchers, PhD students and research contracts in 2013-2017

Researchers and students	2013	2014	2015	2016	2017
No. of integrated researchers	51	55	47	50	52
No. of Integrated researchers with PhD	51	55	47	50	52
No. of PhD students advised by integrated members of the R&D Unit	17	16	9	5	5
No. of research contracts with national public or private entities	5	3	2	2	0
No. of research contracts with international bodies	0	0	0	0	0

Part 3: Research team with links to CVs and ORCID record

08. Lists of researchers in the current application

8.1 List of the Integrated Researchers of the R&D Unit who hold a PhD degree

Name	Nuclear CV	ORCID id
Lisete Maria Ribeiro de Sousa	Yes	0000-0002-2114-720X
Amílcar Manuel do Rosário Oliveira	No	0000-0001-5500-7742
Ana Luisa Trigo da Silva	No	0000-0002-2918-8364
Carina Soares da Silva	No	0000-0003-1021-7935
Carlos Daniel Mimoso Paulino	No	0000-0001-9473-7641
Carlos José Brás Geraldes	No	0000-0002-1551-6531
Clara Maria Henrique Cordeiro	No	0000-0002-1026-6078
Cristiana Maria Palmela Pereira	No	0000-0002-9164-7189
Délia Canha Gouveia Reis	No	0000-0002-5087-3120
Dinis Duarte Ferreira Pestana	No	0000-0001-8999-1354
Fernanda Otilia de Sousa Figueiredo	No	0000-0003-0255-4106
Giovani Loiola da Silva	No	0000-0002-7434-2383
Helena Alexandra Couceiro Feio de Almeida Penalva	No	0000-0002-3907-5187
Ivone Maria Ribeiro Figueiredo da Silva Rosa (CO-ORIENTADORA)	No	0000-0003-4905-8134
João Paulo Oliveira Martins	No	0000-0002-0474-1397
Jorge Filipe Campinos Landerset Cadima	No	0000-0003-3226-0184
José Leonel Linhares da Rocha	No	0000-0001-8053-6822
Kamil Feridun Turkman	Yes	0000-0002-6864-8773
Laurentius Franciscus Maria de Haan	Yes	0000-0001-6591-6018
Luisa da Conceicao dos Santos do Canto e Castro de Loura	No	0000-0001-7890-8746
Luzia Augusta Pires Gonçalves	No	0000-0002-9710-1945
Maria Antonia Conceição Abrantes Amaral Turkman	No	0000-0002-7564-7154
Maria de Fátima Almeida Brilhante	No	0000-0001-9276-7011
Maria Fernanda Nunes Diamantino	No	0000-0002-9217-167X
Maria Helena Neves de Queirós Gonçalves	No	0000-0002-6990-7239
MARIA ISABEL FRAGA ALVES	No	0000-0003-3824-2403
MARIA IVETTE LEAL DE CARVALHO GOMES	Yes	0000-0002-2903-6993
Maria Manuela Costa Neves Figueiredo	No	0000-0003-2468-3857
Maria Salomé Esteves Cabral	No	0000-0003-4462-4811
Marília Cristina de Sousa Antunes	No	0000-0002-1257-2829
Miguel Martins Felgueiras	No	0000-0001-5450-7374
Patricia Cortes Zea Bermudez	No	0000-0002-7683-228X
Paula Cristina Martins dos Reis	No	0000-0003-2266-6375
Paula Cristina Sequeira Pereira	No	0000-0002-9326-1466
Paulo José Figueira Semblano	No	0000-0001-6557-3318
Ricardo Miguel Vieira de São João	No	0000-0003-3137-0891
Rui Filipe Vargas de Sousa Santos	No	0000-0002-7371-363X
Sandra Cristina de Faria Ramos	No	0000-0001-5788-1679

Name	Nuclear CV	ORCID iD
Sandra Maria da Silva Figueiredo Aleixo	No	0000-0003-1740-8371
Sandra Maria Freitas Mendonça	No	0000-0003-3364-0357
Teresa Paula Costa Azinheira Oliveira	No	0000-0003-3283-9946
Tiago André Lamas Oliveira Marques	Yes	0000-0002-2581-1972
Valeska Lima Andreozzi	No	0000-0001-6478-8456

8.2 List of the Integrated Researchers of the R&D Unit who do not hold a PhD degree

Name	Is PhD Student?	ORCID iD
Ana Sofia Monteiro de Araújo Soares	Yes	0000-0001-6953-0657
César Duarte Alves da Rocha	Yes	0000-0002-4692-7712
Ivo Miguel Sousa Ferreira	No	0000-0001-5526-3594
Jessica Silva Lomba	No	0000-0003-2128-4316
João David Ferreira de Castro Albuquerque	Yes	0000-0001-9151-2121
José Alberto Ferreira de Castro Pereira	No	0000-0002-3210-4360
Maria da Conceição Dias Leal	Yes	0000-0003-3803-6204
Marta Susana Ferreira Leitão Alves	No	0000-0002-7421-8550
Sandra Cláudia Matias Rodrigues	Yes	0000-0001-8238-8245
Soraia Alexandra Gonçalves Pereira	Yes	0000-0002-7336-1320
Tiago Miguel Dias Domingues	Yes	0000-0002-4034-4276

8.3 List of the Collaborator Researchers of the R&D Unit

Name	ORCID iD
Adelaide Maria de Sousa Figueiredo	0000-0002-5734-3851
Ana Maria Santos Ferreira Gorjão Henriques	0000-0002-9597-6385
Björn Jochen Vandewalle	
Carlos do Carmo de Portugal e Castro da Camara	0000-0003-1699-9886
Cláudia Margarida Pedrosa Neves	0000-0003-1201-5720
Cristina Maria Tristão Simões Rocha	0000-0001-7162-4820
Dora Susana Raposo Prata Gomes	0000-0002-5165-2346
fernando jose araujo correia da ponte sequeira	
Filipe José Gonçalves Pereira Marques	0000-0001-6453-6558
Frederico Almeida Gião Gonçalves Caeiro	0000-0001-8628-7281
Helena Maria Iglésias Pereira	0000-0001-9426-9251
Ines Pereira Silva Cunha de Sousa	0000-0002-2712-1713
Isabel Cristina Maciel Natário	0000-0001-6020-9373
João Miguel Paixão Telhada	0000-0001-6353-6329
José Antonio Seijas Macias	0000-0002-6056-3257
José Miguel Oliveira Cardoso Pereira	0000-0003-2583-3669
Ligia Carla Pinto Henriques Jorge Rodrigues	0000-0003-4881-4188
Luis Filipe Meira Machado	0000-0002-8577-7665
LUÍS MIGUEL DOS SANTOS REIS SOARES DE ALMEIDA	0000-0003-4026-6105
Manuel Gonzalez Scottó	0000-0001-8427-2684
Maria Cristina Souto Miranda	0000-0002-4642-5683
Maria da Conceicao Rodrigues Ribeiro	0000-0003-0185-3200
Maria da Graça Santos Temido Neves Mendes	0000-0002-5159-0528
Maria João Fernandes Pereira Polidoro	0000-0002-2220-4077
Maria Joao Teixeira Martins	0000-0002-1328-7579
Maria Lucília Salema e Carvalho	0000-0003-3307-1844
Marta Susana Ribeiro Ferreira	0000-0001-7247-3825
Miguel Brás de Carvalho	0000-0003-3248-6984
Nuno Henriques dos Santos de Sepulveda	0000-0002-8542-1706
NUNO MIGUEL BATISTA BRITES	0000-0002-5719-6310
Paulo José de Jesus Soares	
Pedro Rui Mazedo Gil	0000-0003-0887-5939
Raquel Menezes da Mota Leite	0000-0001-5552-917X
Regina Maria Baltazar Bispo	0000-0002-6723-2557
Rita Maria César e Sá Fernandes de Vasconcelos	
Rui Manuel da Costa Martins	0000-0003-1862-7066
Sílvia Maria Dias Pedro	
Sílvio Filipe Velosa	
Vanda Calhau Fernandes Inácio	0000-0001-8084-1616

09. PROPOSED RESEARCH GROUPS

The minimum number of confirmed integrated researchers in order to fill research groups information is 50 and you have only 43.

Part 4: Plan of Activities for 2018-2022

10. Summaries of the Plan of Activities for 2018-2022

10.1 Summary in Portuguese for general dissemination purposes

O Centro de Estatística e Aplicações (CEAUL) está sediado no Departamento de Estatística e Investigação Operacional da Faculdade de Ciências da Universidade de Lisboa.

Criado em 1975 por Tiago de Oliveira, o CEAUL desempenha um papel central em Portugal uma vez que é o único centro dedicado exclusivamente à investigação metodológica nas grandes áreas de Probabilidade, Estatística e Processos Estocásticos e suas aplicações. É um centro com atividades interdisciplinares, onde se alia investigação fundamental à investigação aplicada em domínios tão diversos como Ciências da Vida e da Saúde, Ciências Naturais e do Ambiente e Ciências Sociais (particularmente em Risco Financeiro). A política seguida no CEAUL tem sido a de promover fortes ligações com outras áreas e domínios científicos. Neste sentido tem realizado frequentemente seminários, cursos, encontros e participado na divulgação da Estatística.

Num sentido muito geral, a Estatística é o estudo da incerteza presente em fenómenos onde o mecanismo aleatório desempenha um papel especial. Os estatísticos são cientistas que desenvolvem instrumentos para medir este tipo de incerteza e quantificar os riscos associados à possível tomada de decisões em contextos de incerteza. Consequentemente, a Estatística desempenha um papel primordial em problemas em que o ingrediente principal é a variabilidade inerente que conduz à incerteza associada.

Sendo uma disciplina relativamente jovem, a Estatística conheceu os seus maiores desenvolvimentos a partir de meados do século XX. No entanto, com o advento dos computadores e a grande capacidade atual de recolha e armazenamento de dados, não só o paradigma original da Estatística tem vindo a mudar rapidamente, como também o apoio do estatístico é cada vez mais necessário para dar uma resposta adequada a problemas suscitados numa grande variedade de atividades de investigação e desenvolvimento científico. Em consequência, a estratégia desta Unidade é a de (1) acompanhar os novos avanços no domínio científico da Estatística e continuar a fazer investigação fundamental nas suas áreas de excelência, desenvolvendo novas metodologias e técnicas de modo a poder transferir o uso dos conhecimentos mais atualizados na colaboração com investigadores de outros campos científicos; (2) integrar projetos nacionais e internacionais de natureza interdisciplinar; (3) participar na Sociedade, dando apoio científico à Indústria, Comércio, Serviços e Administração; (4) promover atividades de formação avançada através de programas doutorais e cursos de especialização em áreas emergentes da Estatística; (5) promover a iniciação científica e integração de jovens investigadores.

Para implementar a estratégia proposta, o CEAUL conta com 54 investigadores integrados (11 não doutorados), de diversas Universidades e Institutos Politécnicos do País e 38 colaboradores pertencentes a outras Unidades de Investigação das áreas da Matemática e das Ciências do Ambiente, da Vida e da Saúde.

10.2 Summary in English for general dissemination purposes

The Centre of Statistics and its Applications (CEAUL) is a research and development (R&D) unit connected to the Department of Statistics and Operational Research at the Faculty of Sciences of the University of Lisbon.

Established in 1975 by Tiago de Oliveira, CEAUL plays a central role in Portugal as the only R&D unit dedicated exclusively to fundamental research in the areas of Probability, Statistics and Stochastic Processes. Besides fundamental research, CEAUL is also dedicated to interdisciplinary activities in domains as diverse as Life, Health, Natural and Environmental Sciences and Financial Risk. CEAUL's policy has been to develop strong links with other areas and scientific domains. In this sense, it organizes seminars, courses, meetings and participates in the dissemination of Statistics.

In a very general sense, Statistics may be viewed as the study of the uncertainty arising from any phenomena and situations where chance mechanisms have a key role. Such study aims at describing the characteristics of interest in each practical situation and providing guidance for the making of decisions in contexts of unpredictability. Given the unavoidable randomness inherent to the vast majority of real world phenomena, statistical thinking today infuses so many scientific fields that it plays a crucial backdrop to the advance of the Science in general.

Statistics, as a scientific discipline, is relatively young with its foundations and main developments dating back to the XX century. However, with the advances of technology and consequent capacity for acquisition and data warehouse, the paradigm of Statistics has been changing in a fast speed. Statistical support is more and more required to give adequate answers to problems posed in a great variety of research activities. Consequently the strategy of this research unit is to (1) keep pace with the recent advances in the scientific domain of Statistics, to continue fundamental research in its areas of excellence, developing new methodologies and tools with the goal of communicating and using the most up-to-date knowledge, while collaborating with researchers from other scientific areas; (2) participate in national and international projects of an interdisciplinary nature; (3) participate actively in Society by giving support to Industry, Commerce, Services and Business; (4) develop advanced training activities through the involvement in PhD programs of High Education Institutions and the organization of advanced courses in emerging areas of Statistics; (5) integrate and initiate scientifically young researchers.

To carry out the objectives set and to implement the proposed strategy, CEAUL has 54 integrated researchers (11 non-PhD), coming from a range of Universities and Polytechnic Institutes from continental Portugal, Madeira and Azores, and 38 collaborators who are integrated members in other research units from the area of Mathematics, Environmental and Health Sciences.

10.3 Summary in English for evaluation

The Centre of Statistics and its Applications (CEAUL) is a research and development (R&D) unit connected to the Department of Statistics and Operational Research (DEIO) at the Faculty of Sciences of the University of Lisbon (FCUL). FCUL provides physical facilities, general computing infrastructures and communications, needed for the prosecution of its activities. The Association for Research and Development of CIÊNCIAS (FCiências.ID), the main host institution, supplies administrative and financial R&D management.

Established in 1975 by Tiago de Oliveira, CEAUL plays a central role in Portugal as the only R&D unit dedicated exclusively to fundamental research in the areas of Probability, Statistics and Stochastic Processes. Besides fundamental research, CEAUL is also dedicated to interdisciplinary activities in domains as diverse as Life, Health, Natural and Environmental Sciences and Financial Risk.

CEAUL is a member of CNM-Adhering Organization and Committee for Mathematics/ International Mathematical Union and is an associated member of CIM-International Centre of Mathematics. It has close connections with the Portuguese National Institute of Statistics (INE), through the editorial support given by senior members of CEAUL to REVSTAT-Statistical Journal, an international journal in the area of Probability and Statistics, edited by INE and indexed by the ISI Web of Knowledge. At the international level CEAUL is connected to several prestigious universities through scientific collaboration and participation of its members in networks and research activities. CEAUL integrates BIOSTATNET, an interdisciplinary Biostatistics network, and PT-MATHS-IN, a member of the European Service Network of Mathematics for Industry and Innovation.

In a very general sense Statistics may be viewed as the study of the uncertainty present in phenomena and situations where chance mechanisms have a key action. Such study aims at describing the characteristics of interest in each practical situation and

providing guidance for the making of decisions in contexts of unpredictability. Given the unavoidable randomness inherent to the vast majority of real world phenomena, statistical thinking today infuses so many scientific fields that it plays a crucial backdrop to the advance of the Science in general. Statistical theory and methodology cannot exist divorced from the needs of other sciences felt by the corresponding researchers and users.

Statistics, as a scientific discipline, is relatively young with its foundations and main developments dating back to the XX century. However, with the advances of technology and consequent capacity for data acquisition and storage, the paradigm of Statistics has been changing fast and statistical support is increasingly required to provide adequate solutions to problems posed in a great variety of research activities. Consequently the strategy of CEAUL is to keep up to speed with the recent advances in Statistics, to continue fundamental research in its areas of excellence, using the most up-to-date knowledge to develop and communicate new methodologies and tools, while collaborating with researchers from other scientific areas.

Therefore the strategic program of CEAUL for 2018-2022 has the following objectives:

1. Develop fundamental research on diverse domains of Statistics, aiming to extend the frontiers of statistical knowledge and provide statistical tools for experimental sciences, in close collaboration with researchers from other domains and scientific areas.
2. Participate in interdisciplinary national and international projects.
3. Participate actively in Society by giving support to Industry, Commerce, Services and Business in the form of consultancy or specialized courses.
4. Develop advanced training activities through the involvement in PhD programs of High Education Institutions and the organization of advanced courses in emerging areas of Statistics.
5. Encouraging young students into research, by involving them in the Centre's activities.

CEAUL organizes internally its members into two groups, according to the following lines of research: (1) Order Statistics, Extremes, Modelling and Simulation and (2) Statistical Models and Methods for Complex Systems.

Fundamental research will be carried out, in a diversified range of themes including but not restricted to, Statistics of Extremes, Computational Statistics and Simulation, Resampling Methodologies, Quality Control, Bayesian Statistics, Biostatistics, Environmental Statistics, Statistics in Genomics, Immunology and Epidemiology, Statistics in Medicine, Longitudinal Models and Survival Analysis, Time Series Analysis, Incomplete Data Analysis, Multivariate Analysis, Temporal and Spatial Statistics, Design of Experiments, History and Teaching of Statistics. Although the two groups work in different themes and areas of Statistics, they share similar interests in terms of areas of application. The main areas are Environmental and Ecological Statistics, Statistics in Life Sciences and Biostatistics, and Risk in Financial Extremes. The members working in these areas collaborate with researchers coming from other fields of science. This collaborative work is done either at an individual level, or through the participation in national and international projects. Knowledge transfer, in terms of consultancy work, participation in projects coming from the Industry, Services and Public Administration, is also a strategic objective of the areas of application.

To carry out the objectives set and to implement the proposed strategy, CEAUL counts with (i) 43 integrated PhD researchers, coming from a range of Universities and Polytechnic Institutes from North to South of Portugal, Madeira and Azores; (ii) 38 collaborators who are integrated members in other research units from the area of Mathematics, Environmental and Health Sciences, and 11 integrated non-PhD (seven of them are PhD students).

11. Description of the Plan of Activities for 2018-2022

11.1 Objectives and strategy of the R&D Unit for 2018-2022

CEAUL has a new coordinating team since January 2017. This team is relatively young, has initiative and new ideas to improve the centre's activity. The main objectives of this team are: create, innovate, internationalize, promote interdisciplinarity and cohesion of the research group, motivate and integrate less productive researchers, increase critical mass, rejuvenate the centre through the inclusion of young researchers, and renew the image of the centre through the creation of a new logo and a more attractive and informative webpage.

Regarding future work and new developments, we chose 4 topics, among several others, covering the main strategic areas of CEAUL for 2018-2022:

Statistical Extremes: Holder's mean-of-order- p estimation procedures will be developed under non-regular frameworks. Lehmer's mean, one of the main topics of a recent PhD thesis, and other generalized means will be taken into account. Threshold selection will be intensified. Heteroscedastic extremes, developed for proportional tails, will be considered under a more general framework. A similar comment applies to truncation, where we further intend dealing with the consideration of covariates and heteroscedasticity.

Environmental Statistics: There is one ongoing FCT project with researchers from CEF on wildfire management and risk in rural urban interface (RUI), where members of CEAUL are responsible for a task on probabilistic models for fire risk in the RUI. With researchers from CEF, IDL and IPMA we are proposing a project within a recently opened FCT call where our intervention will be on modeling the daily spatial variation of ignition probabilities at a desired resolution, modeling the spatial variation of the probability of extreme wildfires, construction of optimal alarm systems for extreme fires with generation of easy-to-read tables displaying the probability of a fire going extreme based on covariate information.

Ecological Statistics: Ballast water (BW) is used to maintain the stability and balance of vessels and to ensure their structural integrity. BW that is taken in one ecological region and discharged into another can introduce non-native aquatic organisms that may become invasive with a big detrimental impact on the local biodiversity, economy and health. Currently, IMO member states are required to check whether the ships comply with the regulations (treatment to remove, kill or neutralize organisms prior to discharge) and this often includes BW sampling, a complex task because of the many and varied factors that must be considered. This issue is part of a project by a team joining a CEAUL member to researchers from S. Paulo University, Brazil. Frequentist and Bayesian approaches, involving distinct models for the organism concentration in the BW tank, will be applied for determination of the number of aliquots of BW and corresponding volumes required for compliance with the standard D-2 regulation.

Big Data: Due to the emerging field of Big Data, Artificial Neural Networks (ANNs) are presently viewed as a good alternative to statistical methodologies. Similarly to what has been proposed regarding Generalized Additive Neural networks, research will go on into the direction of transforming this ANNs approach into a more appealing tool regarding applicability and interpretability of the results. Additionally, research will also focus on the development of hybrid models (combining statistical and ANNs approaches) and in pattern recognition namely by using Convolutional Neural Networks for Visual Recognition. The ultimate goal is to develop methodologies that are more suited to deal with Big Data without neglecting interpretability of the results. These methodologies will consequently have higher odds of being used in a wider range of research areas, namely in medical research. CEAUL is one of the driving forces of the PhD program in Statistics and Operational Research of Lisbon University. Besides,

members of CEAUL participate in PhD programs in Mathematics/Statistics on other Universities. For 2018-2019 CEAUL has planned 8 courses, 7 of them lectured by international researchers, on: ROC methods for disease diagnosis, Bayesian Analysis via STAN, Spatio-Temporal Data Analysis, Clinical Trials, Item Response Theory and Analysis of Longitudinal Data. CEAUL's members showed interest in courses in Extremes in Insurance, Multivariate Statistics, Functional Data Analysis, Missing Data and Quality Control. CEAUL will look for people habilitated for lecturing these courses and will continue offering advanced courses on emerging areas of Statistics for researchers and advanced students, as well as courses on more general areas of Statistics. Initiation of young researchers will be promoted by CEAUL, through (a) summer internships for graduate students (as it was done in 2015 and 2017 with Starfactor and hmR, respectively); (b) collaboration of graduate and MSc students with CEAUL members on their investigation projects or with PhD students; (c) MSc theses in the scope of CEAUL networks and collaborative companies. Moreover, FCT support for these graduate and MSc students through the Base Finance will be essential to motivate young students for research, giving rise to potential PhD students and young PhD researchers for CEAUL.

In 2018 CEAUL is sponsoring and participates in the organizing committee of the European Conf. on Mathematical and Theoretical Biology, in collaboration with the CMAF-CIO. Also, the III Luso-Galaico Meeting will be sponsored by CEAUL, while some members participate in the organizing and scientific committees. In 2019-2022 CEAUL will certainly sponsor other international meetings and plans to organize 2 or 3 conferences/workshops on its strategic research areas, subject to researchers' availability.

In 2018 there will be 14 seminars (4 international), plus 6 seminars under MSc Biostatistics. However there will certainly be more seminars given by foreigner researchers who come to work with CEAUL members. In 2019-2022 an annual average of 16 seminars, like it happened in previous years, will be maintained.

The proximity among R&D units and companies helps to build a more modern and up-to-date Portugal. In this sense, CEAUL is planning forms of contracting to the following companies/institutions starting in 2018-2019: hmR (Health Market Research), cme (activities for electricity, telecommunications and industrial management), IPMA, Novartis, Starfactor and Exigo (Statistical Consulting). These companies see in CEAUL a source of knowledge and the possibility of applying advanced statistical methods that they are not able to implement. IPMA will hire CEAUL under an approved project on Small Fisheries, and there is the need of hiring a PhD researcher (partially financed by the project) and a PhD student. For both, CEAUL needs FCT support through the Base Finance.

CEAUL will maintain collaboration with statistical groups of other research units whose members are in the list of collaborators: National - FMDUL, IPMA, IDL, CMA, CEMAT, CMAF-CIO, CEF.UP, LIAAD-INESC TEC Porto, CMBA; International - University of Edinbrugh, University of Reading, London School of Hygiene and Tropical Medicine, University of S. Paulo, and many other international researchers with whom CEAUL members have been collaborating. Moreover, CEAUL members will continue collaborating with researchers from the R&D units BIOISI (Biology and Biochemistry), LASIGE (Informatics), or with the institutes IGC, IPO (Oncology), IMM (Neurosciences and Genetics Groups), INSA (Epidemiology, and Non-Communicable Disease Prevention Departments).

Researchers will continue participating in Seminars, Workshops, Conferences, Courses and other international meetings. The goal is to keep themselves up-to-date with scientific advances, to present their work to international peers, and to interact with expert researchers looking for scientific collaboration. As a result, it is expected a good portfolio of collaborative publications in peer-reviewed International Journals. It is intended to encourage researchers to publish their work as technical reports to make them available online before being published in peer-reviewed Journals.

CEAUL will maintain the following activities: (a) editorial support given by senior members to REVSTAT; (b) update of the Portuguese Statistical Glossary and collaboration in the SPE newsletter, both as part of the joint activities with SPE; (c) continue promoting the cycle of meetings Mathematics, Statistics and Applications. A member of CEAUL is a statistical consultant for the Medical Journal - *Ata Médica Portuguesa*. The president of the Biometry section is also a member of CEAUL.

CEAUL will establish a partnership with the National Reading Plan which plans for the next 10 years the consolidation of a partnership policy, considered fundamental for the creation of a social environment favourable to the valuation of books, reading, and cultural and scientific experience. The partnership with CEAUL may include: (a) scientific dissemination, including biographies of scientists; (b) reporting of bad science; (c) scientific journalism; (d) science in poetry and fiction. CEAUL contacted a well-known international speaker, to emphasize the importance of statistics as essential and transversal to all areas of knowledge.

Unfortunately this importance is not yet globally recognized in Portugal, so we often see the poor use of statistics in areas that interfere with our lives as Medicine and Economics. The speaker was invited to give a lecture on the thematic of bad use of statistics, as well as interacting with students and promoting good practice in statistics.

CEAUL will continue to be part of the BIOSTATNET and PT-MATHS-IN networks. A project was submitted in 2017 for funding under the Interreg SUDOE program, encompassing the European territorial cooperation objective between Spain, France and Portugal.

11.2 Organization of the R&D Unit for 2018-2022

The governing bodies of CEAUL and corresponding responsibilities are the following:

- 1 - The Scientific Coordinator ensures the scientific and management leadership of the unit within the scope of its attributions conferred by the FCT, namely: coordinate Unit's resources in order to ensure the fulfilment of its objectives, represent the Unit, regularly communicate the amount of funds transferred by the funding body to the senior researchers responsible of the main areas of interest, authorize Unit expenses, and propose to the Coordinating Committee the method of distribution of the funds allocated to the Unit. It is also of the responsibility of the Scientific Coordinator to preside and summon meetings of the Coordinating and Executive Commissions, and of the Scientific Committee, as well as to reveal the respective minutes to the doctoral members of the team. The Scientific Coordinator of the Unit is assisted in its activities by the Vice-Coordinator, Executive Committee, in which it can delegate some of its functions, and also by a Technical Secretary. Still, for supporting the scientific activities of the centre, specifically the organization, scheduling and tracking of scientific, academic and editorial projects, the Unit will share a Science and Technology Manager with CMAF-CIO (50% each).
- 2 - The Scientific Vice-Coordinator assists the Scientific Coordinator of the Unit in its activities.
- 3 - The Coordinating Committee composed by the Scientific Coordinator, the Scientific Vice-Coordinator, and by the researchers that are responsible for the main areas of research, is in charge of the following tasks:
 - to prepare, for approval by the Scientific Council of the Unit, the annual report, the plan of activities under the Pluriannual R&D Financing Programs, as well as the budget of the Unit;
 - to approve the method of distribution of the funds allocated by the funding entity to the Unit per capita, divided by the organic unit for general expenses of the Centre and by the main areas of research;
 - to decide about general utility acquisitions for the unit;
 - to decide, in accordance with the CEAUL statutes, on the admission of new members and the exclusion of members, as well as

the possibility of transferring some of the integrated members to collaborators;

- to approve the constitution of the External Scientific Advisory Board.

Moreover, the responsible researchers for the main areas of applications will collect the data to elaborate the reports of the activities of its members and plan of activities (submitted for evaluation and candidature for the Multiannual Funding of the R&D Units), to represent the area whenever necessary, and to ensure that management of the budget is made in accordance with the principles adopted by the Coordinating Committee. It is the responsibility of these researchers to maintain effective contact with the Scientific Coordinator of the R&D Unit, and shall meet with its members on a regular basis in order to ensure the cohesive structure of its research purposes and to provide information on the management of resources within the area of application.

4 - The Executive Committee is composed by the Coordinator and four PhD integrated members, chosen by the Centre's Coordinator:

- to give updated visibility of the Centre by disseminating public outreach activities within the scope of the Centre's objectives;

- to advertise scientific publications;

- to promote the organization of seminars and conferences, advertising them through of the CEaul webpage update.

5 - The Scientific Council is composed by all PhD members integrated in the Unit and is chaired by the Centre's Scientific Coordinator:

- to appreciate and approve the plan and report of the Unit activities, as well as the budget;

- to elect the Scientific Coordinator.

An annual meeting of the Scientific Council will take place.

In order to optimize its research activities and achieve results of excellence, CEaul has organized internally its members into two groups according to the following main areas of research: (1) Order Statistics, Extremes, Modelling and Simulation and (2) Statistical Models and Methods for Complex Systems.

The first group is going to work in different but related topics of Statistics, within the general field of Order Statistics and Applications and the main topics of research are: Extreme Value Theory, Statistical Quality Control, Computational Statistics, Resampling Methodologies, Functional Methods in Probability, Stable and Extreme Models, Population Dynamics, Sampling, Risk Processes, History of Probability and Statistics and Meta-Analysis, and Experimental Design. M. Ivette Gomes, an expert with large experience in these areas of research of which we emphasize Extreme Value Theory, is going to be the responsible of this group. There will be a co-responsible, Dinis Pestana, also an expert with large experience in these areas of research of which we emphasize Functional Methods in Probability.

The second group has been motivated by problems in areas of Environmental, Life and Health Sciences, and the main topics of research are: Spatio-temporal analysis, Non-linear Time Series, Spatial Extremes, Stochastic and Epidemic processes, Survival Analysis, Generalized Linear/Additive Mixed Models, Latent Class Models, Categorical and incomplete Data Analysis, Multivariate Statistics, Statistical Screening and Supervised Classification Methods, Statistics in Genetics. M. Antónia Turkman, an expert with large experience in these areas of research of which we emphasize Bayesian Statistics, is going to be the responsible of this group.

Although each group has its own line of research, an overlap of some of the research themes is inevitable, and in both groups all members are encouraged to do methodological research, although some will contribute more on the applications. The activities of core teams on methodological work are coordinated by a group leader. All members are committed to contribute with their time and knowledge towards the success of the initiatives of thematic strands, participating in the tasks which the thematic leaders assign to them. Researchers from the different partner institutions are encouraged to interact with each other, through statistical research, organization of scientific events, supervision of MSc and PhD students, among other activities that will reinforce the Unit's cohesion.

To advise on the scientific orientation of the research to be carried out by CEaul, an External Scientific Advisory Board composed of individuals of recognized merit, national and foreign, in the areas of Probability, Statistics and its Applications was established. An annual meeting with the Advisory Board will take place and its organization will be of the responsibility of the Executive Committee.

12. Thematic Lines

The minimum number of confirmed integrated researchers in order to fill thematic lines information is 100 and you have only 43.

13. Ethical issues

13.1 Ethical issues

This unit will follow the general ethical guidelines applicable to all sciences and in particular will follow closely the American Statistical Association (ASA)'s Ethical Guidelines for Statistical Practice. We quote ASA on this issue:

- Statistical tools and methods, as with many other technologies, can be employed either for social good or evil. The professionalism encouraged by these guidelines is predicated on their use in socially responsible pursuits by morally responsible societies, governments, and employers. Where the end purpose of a statistical application is itself morally reprehensible, statistical professionalism ceases to have ethical worth-.

The complete set of guidelines can be found in <http://www.amstat.org/about/ethicalguidelines.cfm>

Since we collaborate with other scientists from Engineers to Medical Doctors, whose results and research findings have direct consequences on the well-being of the Society, we give extreme care in statistical analysis to make sure that conclusions taken from planned experiments and consequent data analysis will reflect the true state of the nature.

14. Aspects of the Plan of Activities involving requests of Programmatic Funding

14.1 Pluriannual plan for PhD fellowships to be awarded in 2019-2022

NAME OF INSTITUTION THE PHD PROGRAM	DATE OF ACCREDITATION	PRESENTLY FUNCTIONING	R&D UNIT INVOLVEMENT/ CONTRIBUTION OF PHD RESEARCHERS/SCOPE OF THE WORK	2019 2020 2021 2022				NO. OF EXPECTED FELLOWSHIPS
Estatística e Faculdade de 2015 Investigação Ciências da Operacional Universidade de Lisboa		Yes	The Faculty of Sciences from Lisbon University (FCUL) is the only faculty in Portugal offering PhD programs on Statistics and Operational Research, having international recognition on the key areas of Statistics and Operational Research, such as but not only Extreme Value Theory, Bayesian Statistics, and Discrete and Network Optimization. The preparation of a thesis consisting of original methodological advances as well as applications enlarges the frontier of knowledge in Statistics. CEAUL members may supervise theses on the following areas of specialization of this PhD: Numerical Analysis and Simulation; Biostatistics and Bioinformatics; Experimental Statistics and Data Analysis; Probability and Statistics. The PhD student must be supervised by a member of CEAUL, which is also a Professor at FCUL, however the student may be co- supervised by a member of CEAUL belonging to a partner institution. We expect to hire four PhD students to work specifically on four of the most active research areas in terms of scientific production, of CEAUL: (1) Order Statistics, Extremes, Modelling and Simulation; (2) Artificial Neural Networks; (3) Bayesian Statistics and (4) Biostatistics. The integrated members of CEAUL will be invited to propose PhD projects on these thematic lines, and the Executive Commission will select four projects per theme. The selected projects will constitute the four PhD scholarships. CEAUL will continue to integrate PhD students as integrated members, as soon as they finish their PhD.	2	2	0	0	4

14.2 Pluriannual plan for hiring new researchers holding a PhD in 2019-2022

NEW RESEARCHERS TO HIRE 2019 2020 2021 2022 Total

No. researchers 1 0 1 0 2

Short description of the type of researchers to hire, their expected added-value to the R&D Unit activities, expect contract duration, conditions of co-responsibility of higher education or research institutions through which the contracts will be awarded, and of the financial and material conditions that still need to be fulfilled.

CEAUL wants to hire two PhD researchers, holding a PhD in Probability and Statistics and/or Mathematics. One of the researchers is expected to work directly with hmR (Health Market Research - Portuguese company), as well as being supervised by experienced members of CEAUL, while working in specific problems with advanced statistical methodologies. hmR gathers daily transactions made in pharmacies (sales to end-costomers) throughout the continent and islands, for all market sectors: Pharmaceuticals (including Generics and OTC?s) Dermocosmetics, Medical Devices, Supplements, Nutrition and Animal Health. This symbiotic relationship is good for hmR that, although having a team of statisticians and analysts, does not have time nor expertise knowledge to answer complex problems. CEAUL also benefits to be linked to pharmaceutical industry, since it is a chance of developing new methodologies, to get financial support from an external company, and to hire young researchers for the centre. The contract should last four years, starting in the beginning of 2019 and finishing by the end of 2022. FCIências.ID, the main management institution, has the responsibility to pay the researcher every month. CEAUL asks for 50% of the expenses with the salary of the researcher to be paid by FCT, and the other 50%, plus overheads, travelling expenses, informatics material for

the researcher will be paid by hmR.

The second PhD researcher corresponds of extension, for the years 2021 and 2022, of the contract established with that researcher in the scope of the project with IPMA for 2018-2020 (see section 11.1).

14.3 Support for participation in infrastructures or international networks in 2019-2022

The BIOSTATNET Network, which includes members of CEAUL in the group GALICIA Node, intends to maintain activities in 2018-2020. CEAUL requests support for the following activities: i) teaching a mini-course (2 days) of Bayesian Statistics by CEAUL members in Galicia (University of Santiago de Compostela); ii) receiving Spanish researchers in Portugal to give seminars at CEAUL; iii) organization of the IV Luso-Galaico Meeting of Biometrics in 2020; iv) participation of the Portuguese members in scientific meetings of BIOSTATNET.

The PT-MATHS-IN Network will continue integrating CEAUL as a member in 2018-2022. CEAUL requests support for the following activities: i) travel support to carry out actions to disseminate CEAUL core areas to companies with whom CEAUL may be interested in collaborating; ii) participation of CEAUL members in PT-MATHS-IN scientific meetings; iii) organization of a workshop on Statistics in Industry.

14.4 Other types of support for which the R&D Unit requests Programmatic Funding in 2019-2022

In order to prepare young students to do research and motivate them for an academic profile, CEAUL has as a strategic plan to 2018-2022, for which some finance is needed: (1) open four fellowships for MSc students in Probability and Statistics ? one student per year, not only from FCUL but also from other universities that offer MSc programs in Probability and Statistics. The fellowships should support the student for one academic year, for the preparation of the dissertation and the publication of one paper in a peer-reviewed Journal. Once per academic year, the integrated members of CEAUL will be invited to propose MSc projects, and the Executive Commission will select one of them according to the thematic of Probability and Statistics; (2) open four fellowships for graduate students, 6 months each, to work under supervision of CEAUL members.

15. Expected funding and budget for 2018-2022 for evaluation purposes

15.1 Expected funding of the R&D Research Unit for 2018-2022

FUNDING SOURCES (TOTAL FUNDING)	2018	2019	2020	2021	2022	TOTAL (K€)
Fundação para a Ciência e a Tecnologia, I.P. - FCT	93	16	16	16	2	143
R&D Unit Pluriannual funding awarded for 2018	77	0	0	0	0	77
Project funding expected to be received	0	0	0	0	0	0
Expected funding for contracts of researchers with PhD (1)	0	0	0	0	0	0
Expected funding for PhD, PostDoc or other fellowships (2)	16	16	16	16	2	66
Other funding	0	0	0	0	0	0
Other national sources	36	21	31	0	0	88
Funding expected to be received from Participant or Management Institutions	0	0	0	0	0	0
Public sources (3)	14	21	31	0	0	66
Companies, industry and other private sources based in Portugal (3)	22	0	0	0	0	22
Any other funding source (3)	0	0	0	0	0	0
International sources	0	0	0	0	0	0
European Commission (3)	0	0	0	0	0	0
Companies, industry and other private sources not based in Portugal (3)	0	0	0	0	0	0
Other funding sources (3)	0	0	0	0	0	0
Total (K€)	129	37	47	16	2	231

(1) Paid through an institution or directly to researchers with PhD integrated in the R&D Unit

(2) Paid directly to fellows, researchers or students integrated in the R&D Unit

(3) Grants, projects, fellowships, prizes received, etc.

15.2 Expense budget of the R&D Research Unit in the Main Management Institution for 2018-2022

FCiências.ID - Associação para a Investigação e Desenvolvimento de Ciências (FCiências.ID)

Expense Budget items	2018	2019	2020	2021	2022	TOTAL (K€)
Human Resources	20	18	18	0	0	56
Contracts of researchers with PhD	9	18	18	0	0	45
PhD, PostDoc or other fellowships	11	0	0	0	0	11
Contracts of technical or secretarial staff	0	0	0	0	0	0
Researchers external missions	51	0	4	0	0	55
Temporary visiting researchers or consultants	5	0	2	0	0	7
Patents registration and maintenance	0	0	0	0	0	0
Service or product procurement and acquisition	9	0	1	0	0	10
Equipment	8	0	2	0	0	10
Adaptation of facilities and buildings	0	0	0	0	0	0
Other expenses	20	3	4	0	0	27
Total (K€)	113	21	31	0	0	165

15.3 Expense budget of the R&D Research Unit in the other Management Institutions for 2018-2022

15.4 Estimated percentages of application by general expense budget items of Base Funding in case it will be awarded by FCT, I.P. for 2018-2022 following the evaluation

Expense Budget items %

Total 100 %

Expense Budget items	%
	33 %
Human Resources	
Contracts of researchers with PhD	12 %
PhD, PostDoc or other fellowships	13 %
Contracts of technical or secretarial staff	8 %
	30 %
Researchers external missions	4 %
Temporary visiting researchers or consultants	0 %
Patents registration and maintenance	9 %
Service or product procurement and acquisition	4 %
Equipment	0 %
Adaptation of facilities and buildings	20 %
Other expenses	
Total	100 %

16. Justification of the budget for 2018-2022

16.1 Justification of the total proposed budget

Budget for 2018:

The basic needs of this R&D Unit are in human resources, missions, consultants, services and acquisitions. Equipment needs are basically restricted to computing facilities. The expenses in human resources, according to the budget on section 15.2, are due to a PhD researcher, a fellowship for a PhD and for a MSc student. The Unit will continue receiving PhD students, PhD researchers and post-doc who apply through the usual channels to work on themes related to the objectives of the Unit. However, for the prosecution of the objectives of the Unit, we seek for students who will work on very specific problems. The rationale behind the human resources and equipment is given in detail below.

Missions/Visitors: In order to follow recent trends in the scientific area and collaborate fully with international partners, missions are the most important part of the budget. According to the budget for 2018, we plan at least one international mission per person at an expected cost of 1000 euros per integrated PhD researcher, which includes registration, travel expenses and accommodation (total: 43000 euros). We also expect to receive approximately six collaborators (course lecturers, seminars) and members of the advisory board at an expected cost of 600 euros (total: 6000 euros). As it has been in the past, a policy of this R&D Unit is to finance PhD students to attend to conferences, workshops and advanced courses. This is usually done by supervisors, using the budget for missions allocated to them. Extra 8000 euros from Other Nacional Sources will be used for missions of the integrated members and collaborators that are not integrated in other units. In addition, 5000 euros will be used to reinforce the coming of other visitors for lecturing courses, giving seminars and/or work with CEAUL's members.

Services/Products: The maintenance of the webpage will require the services of a technician on regular basis. The estimated cost will be approximately 150 euros per month. Other services include books and purchase of nondurable materials, such as toners, printing material, USB devices, connecting cables, ink cartridges, paper, photocopies and other current expenses relevant to the development of the scientific research, printing scientific papers and technical reports. The R&D unit is renewing its image and needs to create a new logo. If possible, there is also the intention of supporting young researchers collaborating with the members of this unit. In order to promote science, needs to print posters for conferences, pay the publication of scientific papers and support conferences: in 2018 we will support ECMTB2018 and III Luso-Galaico Meeting of Biometry (Total: 3000 euros).

Other expenses: We expect that the overhead paid to the host institution will be kept at 20% concerning FCT funding. For Other Nacional Sources of financing, overheads should be kept at 12%.

Budget for 2019:

Only a contract with IPMA is in an advanced stage. There are other projects being prepared but since they are not submitted we cannot count with that finance. Thus, 12% of the received amount of 21000 euros will be kept as overheads, while 18480 will co-finance the PhD researcher.

Budget for 2020:

Only a contract with IPMA is going on. Thus, 12% of the received amount of 31000 euros will be kept as overheads, while 18480 will co-finance the PhD researcher.

16.2 Justification of the Human Resources component in total proposed budget

Due to budget limitations, the expenses in human resources will be paid or partially paid by Other Nacional Sources.

1 - A contract with a PhD researcher will be established in October 2018 in order to be paid by the amount received from IPMA within this year: 8800 euros (researcher) + 1200 euros (overheads). We expect a young PhD researcher to be hired after concluding PhD, thus the index 33 will be considered for salary, costing to CEAUL 2725.60 euros per month. In 2019, 88% of the amount of 21000 euros will be used to pay part of the expenses with the researcher, per year, as 12% will be for the overheads. We expect FCT to cover the annual amount of 19132 euros (=37612-18480) for FCT co-finance (overhead excluded). For 2020 an amount of 31000, minus 3720 euros overheads will be available for CEAUL. As in 2019, 18480 euros will be used to pay part of the salary of the researcher and the remaining will be used by CEAUL and the supervisors as stated at 16.1. We asked for Programmatic financing for the next two years.

2 - A fellowship for a MSc student, for three months, entirely paid by IPMA on the scope of a project on Small Scale Fisheries (SSF) and Recreational Fisheries, with the aim of designing sampling monitoring programs to estimate catch and effort data of species caught by SSF under a constrained cost environment. This project allocates 4000 euros for CEAUL.

3 ? A fellowship for a Master, will start in February 2018, and will last for 6 months. This non-PhD researcher will be entirely paid by hmR, in a total cost of 8970 euros. We asked for a research position in the Programmatic finance in order to give continuity to this connection.

16.3 Justification of the Equipment component in total proposed budget

The R&D Unit basically needs computing facilities (laptops, desk computers, printers, etc.); we calculate that during this period we have 10000 euros, meaning that only 7/8 members will be able to acquire a computer during 2018-2022. The purchase of this equipment will be phased according to individual needs. Computing facilities are also expected to be given to PhD students and PhD researchers. So, as for missions, the budget allocated to an integrated member for equipment at his/hers request may be spent for the benefit of their students.

17. REVIEWERS PROPOSED BY THE R&D Unit(S)

17.1 Proposed experts for consideration of FCT, I.P. for eventual request of opinion about applications submitted by R&D Units for evaluation

Name	Institution	Email	Scientific Areas
Richard A.Davis	Department of Statistics, Columbia University, New York,USA	rdavis@stat.columbia.edu	Mathematics
Jef (Jozef) Teugels	Katholieke Universiteit Leuven, Belgium	jef.teugels@wis.kuleuven.be	Mathematics
Leonhard Held	University of Zurich, Institute of Social and Preventive Medicine, Switzerland	leonhard.held@ifspm.uzh.ch	Mathematics