Concluding International 'RARE' Conference

La Baule, France, July 3–8, 2016

Held at

Hôtel Le Majestic, La Baule, France

Scientific Program

Organization : **Marie KRATZ** for ESSEC CREAR
with the help **of Kais HAMZA** (Monash Univ., Australia) and **Corina CONSTANTINESCU** (Uliv-IFAM)

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with the support of: **BFA - SFdS (Société Française de Statistique), ESSEC Business School, and Institut and Faculty of Actuaries**

Information on line: **crear.essec.edu/rare-conference**

RARE 2016

Scientific Committee

- the Advisory Board of RARE project
  - Paul Embrechts, ETH Zurich, RiskLab
  - Ragnar Norberg, LSE & Univ. Lyon 1
- the coordinators of RARE project
  - Corina Constantinescu (IFAM - ULIV)
  - Enkelejd Harshova (HEC Lausanne - Unil)
  - Marie Kratz (ESSEC CREAR)
- D. Papachristou, Chief Actuary for Research, General Insurance Supervision Division, Bank of England

Organising Committee

- ESSEC CREAR
  - Marie Kratz
  - Frédérique Jean-Louis
- A special thanks for their help to:
  - Kais Hamza (Monash Univ., Australia)
  - Corina Constantinescu (IFAM-ULIV)

Special 'RARE' issue of the Annals of Actuarial Science

Conference participants are invited to submit their paper as a full-length manuscript for consideration for publication in a forthcoming special issue of the Annals of Actuarial Science devoted to the RARE european project.

All contributions to the special issue will be fully refereed according to the usual rigorous standards of the journal and therefore acceptance of a paper for the RARE conference does not necessarily guarantee acceptance for publication in the Annals of Actuarial Science special issue.

To submit your manuscript for consideration please go to: **https://mc.manuscriptcentral.com/aoas**

First time users will need to register for an account and then when submitting your manuscript please select Special Issue Article as the manuscript type. To help with formatting your article, the journal style guide and instructions for contributors can be found at:
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The RARE Project

As part of a large worldwide network (funded by the Europe Union) working for the last 3 years on Risk Analysis, Ruin theory and Extremes - RARE, we are completing our final 4th year with a concluding event, in which we want to broadcast our latest findings in the areas.

RARE aims at addressing rare events and extremes, analyzing environmental and financial risks using probabilistic tools. Its intention was to create a worldwide network by supporting regular exchange between researchers from the 12 participating institutions from Australia, China, France, India, Japan, Poland, Russia, Switzerland, UK and the USA. It is coordinated by Corina Constantinescu (IFAM Liverpool) and investigates two major themes: 'Risk Modelling' (scientific coordination: Marie Kratz, ESSEC Business School) and 'New Developments on Extremes and Rare Events' (scientific coordination: Enkelejd Hashorva, HEC Lausanne). The advisory board is composed by Prof. Paul Embrechts (ETH Zurich) and Prof. Ragnar Norberg (Université Lyon 1). We have been working for the last 3 years and had so far a fruitful production, with many publications, ongoing projects, seminars, invited and contributed sessions in international conferences. We organized until now 7 international workshops all over the world to share our research and promote the latest results in our fields (you may find information about those activities on our website: http://www.liv.ac.uk/institute-for-financial-and-actuarial-mathematics/research/rare).

We are happy to present here the programme of the workshop that covers a wide range of topics reflecting these 4 intense years of research and contacts. We are glad to see that RARE members of 8 countries among the 10 represented in the RARE project, participate in this conference.

Enjoy the conference!

This project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement no 318984 - **RARE** (**R**isk **A**nalysis, **R**uin theory, **E**xtremes)

RARE 2016

Sunday 3 July 2016

18:00 – 21:00	Welcome at Le Majestic		Cold Buffet

Monday 4 July 2016

9:15 – 9:30	**Marie Kratz**		Opening
	Welcome		
9:30 – 10:30	**Jean Lemaire**	(p.30)	Invited
	La Baule: Birthplace of Bonus-Malus theory		
	Current challenges for Bonus-Malus systems		
10:30 – 11:00	**Weihong Ni**	(p.36)	Talk
	Bonus-Malus with Deductibles		
11:00 – 11:30	**Coffee Break**		
11:30 – 12:00	**Isabel Fraga Alvez**	(p.22)	Talk
	Tailoring heavy tails for a truncated scenario		
12:00 – 13:00	**Paul Embrechts**	`Session 1 (p.20)`	Course
	Topics in Quantitative Risk Managementt		
13:00 – 14:00	**Lunch**		
14:00 – 16:00	**Break**		
16:00 – 17:30	**Posters session 1**		Poster
	Suhang Dai (p.17), Yi Gu (p.24), Haoyu Qjan (p.40),		
	Lewis Ramsden (p.41), Wei Zhu (p.49)		
17:30 – 18:00	**Gennady Samorodnitsky**	(p.43)	Talk
	Multivariate Subexponential Distributions and Their Applications		
18:00 – 18:30	**Marie Kratz**	(p.28)	Talk
	On risk concentration under 2nd order MRV		
18:30 – 19:00	**Florin Avram**	(p.9)	Talk
	Some steps towards managing subsidiary companies in central		
	branch risk networks		
19:00 – 19:30	**Break**		
19:30 – 20:30	**Dinner**		
21:00 – 22:00	**Concert by the CAMBINI Quartet**	(Chapelle du Sacré Coeur)	
	String quartets by Gounod and Beethoven		

RARE 2016

Tuesday 5 July 2016

9:00 – 9:30	**Corina Constantinescu** *Four years of RARE moments*	(p.15)	Opening
9:30 – 10:00	**Keita Owari** *On Convex Functions on Orlicz Spaces with Δ_2-Conjugates*	(p.38)	Talk
10:00 – 10:30	**Sreekar Vadlamani** *CLT for some geometric functionals of excursion sets*	(p.48)	Talk
10:30 – 11:00	**Ronnie Loeffen** *On a class of time inhomogeneous affine processes*	(p.32)	Talk
11:00 – 11:30	**Coffee Break**		
11:30 – 13:00	**Michel Dacorogna** *Capital Allocation and Capital Management*	Session 1 (p.16)	Course
13:00 – 14:00	**Lunch**		
14:00 – 16:00	**Break**		
16:00 – 17:30	**Posters session 2** *Nehla Debbabi (p.19), Zied Gara (p.23),* *Benjamin Schannes (p.44), Giovanni Pagliardi (p.39)*		Poster
17:30 – 18:00	**Junyi Guo** *Portfolio selection and risk control for an insurer in the Levy market under mean-variance criterion*	(p.25)	Talk
18:30 – 20:00	**Working Groups** 5 groups leaders: **John-Paul Broussard, Corina Constantinescu, Jean Lemaire, Alex McNeil, Holger Rootzén**		Working Group
20:00 – 21:30	**Dinner**		

RARE 2016

Wednesday 6 July 2016

9:00 – 10:00	**Fima Klebaner**	(p.26)	Invited
	Limits for the age structure of a population for large carrying capacity		
10:00 – 10:30	**John Paul Broussard**	(p.12)	Talk
	Measuring and Modeling Market Risk for Life Insurance Company Assets: An Application of Extreme Value Statistics		
10:30 – 11:00	**Maud Thomas**	(p.46)	Talk
	Predict extreme Influenza epidemics		
11:00 – 11:30	**Coffee Break**		
11:30 – 12:00	**Shubhabrata Das**	(p.18)	Talk
	Forecasting Mortality Rates and Population Demographics for India Using Lee-Carter Model		
12:00 – 13:00	**Paul Embrechts**	`Session 2 (p.20)`	Course
	Topics in Quantitative Risk Management		
13:00 – 14:00	**Lunch**		
14:30 – 18:30	**Excursion**		
	A boat tour in Parc de Brière (Bréca) and visit of Kerhinet village		
19:00 – 20:15	**Welcome Party** by the city of La Baule		Palais des Congrès
	Conseillère municipale: Dr. Anne Boyé (History of Mathematics, Nantes Univ.)		
20:30 – 23:00	**Reception dinner**		Hôtel le Majestic

Thursday 7 July 2016

9:00 – 10:00	**Richard Smith**	(p.45)	Invited
	Climate Extremes: Attributions and Future Projections		
10:00 – 10:30	**Valérie Chavez Dumoulin**	(p.13)	Talk
	Semi-parametric estimation of non-stationary Pickands dependence function		
10:30 – 11:00	**Sooie-Hoe Loke**	(p.33)	Talk
	Ruin Probability with Delayed Claims and Risky Investments		
11:00 – 11:30	**Coffee Break**		
11:30 – 13:00	**Michel Dacorogna**	`Session 2 (p.16)`	Course
	Capital Allocation and Capital Management		
13:00 – 14:00	**Lunch**		
14:00 – 16:00	**Break**		
16:00 – 17:30	**Posters session 3**		Poster
	Ayan Bhattacharya (p.10), Marcel Bräutigam (p.11), Mikael Escobar-Bach (p.21), Annika Krutto (p.29), Charles Tillier (p.47)		
17:30 – 18:00	**Krishanu Maulik**	(p.34)	Talk
	Extremes of Multi-Type Branching Random Walk: Heaviest Tail Wins		
18:00 – 18:30	**Andrea Collevecchio**	(p.14)	Talk
	Learning processes and generalized urn models		
18:30 – 19:30	**Søren Asmussen**	(p.8)	Invited
	Some Applications of Conditional Monte Carlo to Insurance and Finance		
19:30 – 20:00	**Break**		
20:00 – 21:30	**Dinner**		

RARE 2016

Friday 8 July 2016

9:00 – 10:00	**John Nolan**	(p.37)	Invited
	Semi-parametric estimation for multivariate extreme value distributions		
10:00 – 10:30	**Parthanil Roy**	(p.42)	Talk
	Extreme values for stable random fields indexed by trees		
10:30 – 11:00	**Tomasz Kozubowski**	(p.27)	Talk
	Certain stochastic models connected with random sums and maxima		
11:00 – 11:30	**Coffee Break**		
11:30 – 12:00	**Alexander McNeil**	(p.35)	Talk
	Backtesting Trading Book Models with Realized p-Values		
12:00 – 13:00	**Paul Embrechts**	Session 3 (p.20)	Course
	Topics in Quantitative Risk Management		
13:00 – 14:00	**Lunch**		
14:00 – 15:30	**Round table:** *The Way Forward*		Round Table
	Peter Antal (SwissRe), **Michel Dacorogna** (SCOR), **Paul Embrechts** (ETHZ Risklab), **Fima Klebaner** (Monash Univ.), **Ragnar Norberg** (Univ.Lyon 1), **Dimitris Papachristou** (BoE)		
15:30 – 16:00	**Ending Coffee Break**		

Location

The meeting will be held at La Baule, Hôtel Le Majestic

The talks will be held in plenary conference room (ground floor).

All catering will take place in the restaurant of the hôtel.

Activities

- Concert by the *Cambini quartet*
  Monday, July 4, Chapelle du Sacré Coeur, 21:00 - 22:00
- Excursion in Parc de Brière
  Wednesday, July 6, 14:30 - 18:30
- Welcome Party by the city of La baule
  Wednesday, July 6, Palais des Congrès, 19:00 - 20:15
- Reception dinner
  Wednesday, July 6, Hôtel Le Majestic, 20:30 - 23:00
- Projection of the movie "Les vacances de Mr Hulot"
  Thursday, July 7, Hôtel Le Majestic, 21:30 - 23:00

Søren Asmussen

Some Applications of Conditional Monte Carlo to Insurance and Finance

Thu 18:30 – 19:30 KEYNOTE SPEECH

The crude Monte Carlo methods estimates an unknown number z by the average $(Z_1 + \cdots + Z_R)/R$ where $Z_1, Z_2, \ldots$ are simulated replicates of r.v. Z with $\mathbf{E}Z = z$. Conditional Monte Carlo uses a similar average where the role of Z is taken by $\mathbf{E}[\mathbf{Z} \,|\, \mathcal{F}]$ for some suitable piece of information $\mathcal{F}$. We survey some applications including portfolio loss, ruin probabilities, density estimation and the assessment of VaR. In some of these conditional Monte Carlo serves for variance reduction, in others more for smoothing.

S. Asmussen & K. Binswanger (1997) Ruin probability simulation for subexponential claims. *ASTIN Bull.* **27**, 297–318.

S. Asmussen & D.P. Kroese (2006) Improved algorithms for rare event simulation with heavy tails. *Adv. Appl. Probab.* **38**, 545–558.

S. Asmussen & P.W. Glynn (2007) *Stochastic Simulation. Algorithms and Analysis.* Springer-Verlag.

S. Asmussen & L. Rojas-Nandayapa (2008) Asymptotics of sums of lognormal random variables with Gaussian copula. *Statistics and Probability Letters* **78**, 2709–2714.

S. Asmussen, J. Blanchet, S. Juneja & L. Rojas-Nandayapa (2011) Efficient simulation of tail probabilities of sums of correlated lognormals. *Ann. Oper. Res.* **189**, 5–23.

S. Asmussen & D. Kortschak (2012) On error rates in rare event simulation with heavy tails. *Proceedings of the Winter Simulation Conference 2012* 978–1–4673–4781–5/12.

S. Asmussen & D. Kortschak (2013) On rare event simulation with heavy Weibull tails. *Methodology and Computing in Applied Probability* DOI 10.1007/s11009–013-9371–6.

D. Kortschak & E. Hashorva (2013) Efficient simulation of tail probabilities for sums of log-elliptical risks. *Journal of Computational and Applied Mathematics* **247**, 53–67.

S. Asmussen, P.-O. Goffard & P. Laub (2016) Orthonormal polynomial expansions and lognormal sum densities. *Risk and Stochastics — Ragnar Norberg at 70.* World Scientific

S. Høg (2016) Masters thesis, Aarhus University.

Florin Avram

Some steps towards managing subsidiary companies in central branch risk networks

Mon 18:30 – 19:00 TALK

The Cramér-Lundberg risk model has been called a "bird's eye view" of the insurance industry, much too simple to reflect its complexity; and yet, it has yielded useful qualitative insights. Cramér-Lundberg and Sparre-Andersen risk networks, modeling interactions between several financial companies, hold also this potential. However, multi-dimensional first passage problems are considerably harder than one dimensional ones, and one may only hope to get qualitative insights via approximations, obtained for example by breaking the network into smaller parts. We address here two questions inspired by the need of central branches (CB)/parent companies/financial coalitions to 1) evaluate the profitability of their subsidiaries, and 2) eventually close them if they stop being profitable.

1) A relevant approximation here is to assume the parent company has inexhaustible resources. This decouples i.i.d. subsidiaries, and leads to one-dimensional problems of evaluating the financial health of each branch separately, by classic one dimensional risk measures like ruin probabilities, time in the red, the value of future dividend payments made to the coalition, etc. However, the parent network is still reflected, by keeping some of the parameters of these one-dimensional problems in common, for all the subsidiaries.

Even after the one-dimensional reduction, the choice of an economic principle for evaluating the profitability of subsidiaries is not obvious.

A first intuition is that an acceptable subsidiary must satisfy the classic positive profit condition $p = c - \lambda \int_0^\lambda zF(dz) > 0$. However, this only exploits the mean of the process involved. We propose more sophisticated criteria, obtained by taking into account further features specific to the economic environment of each subsidiary. These include "bail-out zones" $[a_i, 0], a_i \leq 0$, in which the subsidiaries are monitored periodically at the arrival times of Poisson processes with possibly different rates $\pi_i, i = 1, ..., I$, and bailed-out if necessary, with proportional bail-out costs $k_i, i = 1, ..., I$. Our criteria have simple expressions in terms of the W and Z scale functions of the processes involved.

2) A second problem considered is that of stopping to bail-out certain subsidiaries. Several termination criteria are considered.

Ayan Bhattacharya

Strictly stable point processes and regular variation

Thu 16:00 – 17:30 POSTER

Strictly stable point processes were introduced and characterized by Davydov, Molchanov and Zuyev (2008). They showed that such point processes can always be represented as a scale mixture of iid copies of one point process with the scaling points coming from an independent Poisson random measure. However the question about the superposition domain of attraction of a strictly stable point process remained unanswered. In this talk, we shall address this question and give a sufficient condition for a point process to lie in the superposition domain of attraction of a strictly stable point process. This sufficient condition is based on the notion of regular variation on the space of Radon point measures as defined by Hult and Lindskog (2006). It is proved using a heavy-tailed extension of the main result of Subag and Zeitouni (2015). We shall also introduce a class of Cox processes called randomly scaled scale-decorated Poisson point process (SScDPPP) and discuss about their relations to strictly stable point processes. In a more recent work (jointly with K. Maulik, Z. Palmowski and P. Roy), we have used the domain of attraction condition of a strictly stable point process to compute the weak limit of the extremal point process of a multitype branching random walk. In this case, an SScDPPP arises naturally as the limiting point process. This talk is based on a joint work with R. Subhra Hazra and P. Roy.

Marcel Bräutigam

Detecting change-points in bivariate extremal dependence

Thu 16:00 – 17:30 POSTER

Change-point analysis is a standard tool employed in various applications to detect breaks in a given sample. Classical change-point analysis usually aims to detect changes in the mean, variance or the whole distribution. We however consider detecting changes in the tail behavior of a given (iid) sample. The main contribution is to propose a test for a change-point in the bivariate extremal dependence. For this we exploit the fact that a sample of high threshold exceedances allows us to recover an estimate of the angular measure, a probability measure modeling the extremal dependence. This observation is used to propose both parametric and a non-parametric tests for changes in the angular measure. We provide a practical procedure showing how to use our tests and evaluate the approach on simulated as well as real-life data.

John Paul Broussard

Measuring and Modeling Market Risk for Life Insurance Company Assets: An Application of Extreme Value Statistics

Wed 10:00 – 10:30 TALK

We study the optimal asset allocation decision of a Life Insurance's General Account by incorporating downside risk measures, as well as univariate and multivariate extreme value techniques. We also examine how General Account optimal asset allocations are affected by policyholder investment decisions in the Separate Account. Although asset allocations have varied over the past two decades, we find that the current industry allocations to at least one of the primary drivers of life insurer market risk (equities) are close to optimal as of 2013.

Valérie Chavez Dumoulin

Semi-parametric estimation of non-stationary Pickands dependence functions

Thu 10:00 – 10:30 TALK

Statistical methods for modelling multivariate extremes were introduced and developed by Coles and Tawn (1991). Since the marginal distributions of a multivariate extreme value distribution are univariate extreme value distributions, most of the work on multivariate extremes has been focusing on modelling the extremal dependence of max-stable processes.

The dependence structure of a d-variate max-stable process can be summarized by a continuous and convex function A called the Pickands dependence function and defined on the unit simplex $S_{d-1} = \left\{(w_1, \ldots, \omega_d) \in \mathbb{R}_+^d : \omega_1 + \ldots + \omega_d = 1\right\}$. When estimating the Pickands function A, one has to deal with two difficult challenges: The first one is the fact that the dependence of multivariate max-stable distributions cannot have a finite parametrization and the second one is related to the set of conditions that a valid Pickands dependence function should fulfil. Two well-known non-parametric estimators of the Pickands dependence function were proposed by Pickands (1981) and Capérà *et al.* (1997). However, these estimators were proven to be not a valid Pickands function and many new estimators or modified versions of these estimators were proposed, examples are: Deheuvels (1991), Hall and Tajvidi (2000), Fils-Villetard *et al.* (2008), Genest *et al.* (2009), Cormier *et al.* (2014), to name a few.

The resulting estimator of the Pickands function is regularized, in the bivariate case, using constrained median smoothing B-splines and bootstrap confidence intervals are constructed. Finally, we present the results from a simulation study and apply the new methodology to a real dataset. This is a joint work with Linda Mhalla and Philippe Naveau.

Andrea Collevecchio

Learning processes and generalized urn models

Thu 18:00 – 18:30 TALK

We study attraction properties of urns composed of balls with two distinct colours and which evolve over time. This evolution may depend on the composition of the urn as well as certain other factors, external or internal depending on the history of the urn. We prove that, under mild conditions, the model localizes on one of the two colours. We extend our discussion to a system of interacting urns, and a general class of strongly reinforced random walks.

Corina Constantinescu

Four years of RARE moments

Tue 9:10 – 9:30 OPENING

Four years of RARE moments.

Michel Dacorogna

Capital Allocation and Capital Management

Tue -Thu 11:30 – 13:00 INVITED COURSE

Capital management is central to the good governance of modern financial institutions. They are confronted with a rapidly changing environment characterized by the progressive introduction of risk based regulations, resizing of the financial sector, and shareholders who demand transparency in the use of their investment. After having reviewed the various views on capital, we present methods to allocate capital to risk and analyse their consequences on the risk/return of the portfolio of a financial institution. We show the importance of a fair capital allocation and point out various possible axes of research particularly in view of the difficulty concerning the time dimension of contracts. We continue by looking at what is the right amount of capital needed by an institution and establish proper governance rules for determining this amount. In the last part, we examine the structure of capital and the rules for minimizing its cost.

Suhang Dai

Viscosity Solutions for Optimal Stopping Problem of Feller Process and Applications

Mon 16:00 – 17:30 POSTER

We present a general theory of optimal stopping problem when the state process is governed by a general Feller process. No a prior assumption is made on the differential equation satisfied by the state process. We use properties of Feller processes to study properties of the value function. We present conditions under which the value function is the unique viscosity solution of an Hamilton-Jacobi-Bellman (HJB) type equation with the operator given by the generator of the state process. In addition, we will give some examples of levy-type processes.

Shubhabrata Das

Forecasting Mortality Rates and Population Demographics for India Using Lee-Carter Model

Wed 11:30 – 12:00 TALK

While Lee-Carter (LC) model is considered to be the leading framework for mortality risk in the past two decades, it is yet to be used in modelling Indian mortality. This is possibly because of relatively short history of reasonably reliable age-specific mortality figures. The current work is the first such implementation of the model in Indian context. While reliable annual age specific mortality-rate data is available from 1986 onwards, the same for the higher age-groups (75 years and older) is missing for another subsequent decade; hence much of the current research is based on mortality data from 1997 to 2013. Of particular focus and interest is the gender diversity and with that in mind, in this work the LC model is applied separately for the male and female subgroups, in addition to the aggregate population. Combining this forecast of mortality based on LC model, with an ARIMA-based forecast of birth rate, we project the overall age-wise population pyramid for the coming century. Along with projected population figures, practical significance of the projected gender-equity path is examined for the different age-groups. The projected age-dependency ratio is a significant outcome of the undertaken research. Comparison of adaptability of the LC model between the urban and the rural population of India is yet another direction pursued by the present work. However, in absence of reliable data on historical birth rates separately for the urban and rural segment, as well as rural-to-urban migration, the study is limited to projecting mortality rates in the two segments, and not extended to a construction of projected population pyramids separately for the urban or the rural area. The fitted mortality rates are also compared with official mortality rates, which are updated and published infrequently (only twice in this period), leading to examination of the possible impact of the possible refinement in mortality rates on life insurance and pension products in the country. On the methodological front, we explore adaptation of model selection from wider class of ARIMA models in each model implantation, as well as suitability of constraint analysis in the dimensionality reduction stage (singular value decomposition and/or principal component) of the Lee-Carter model. We also examine development of gender-diversity index based on population pyramid.

Nehla Debbabi

A hybrid model for right heavy tailed data. Application in actuarial science

Tue 16:00 – 17:30 POSTER

One of the main issues in the statistical literature of extremes concerns the tail index estimation, closely linked to the determination of a threshold above which a Generalized Pareto Distribution (GPD) can be fitted. Approaches to this estimation may be classified into two classes, one using standard Peak Over Threshold (POT) methods (see *e.g.* Embrechts et al. (1997), Hill (1975), Resnick et al. (1996)), in which the threshold to estimate the tail is chosen graphically according to the problem, the other proposing unsupervised methods, where the threshold is algorithmically determined (see *e.g.* Debbabi et al. (2014), Singh et al.(2012), Carreau et al. (2009)). Our approach is unsupervised and proposes a hybrid distribution for highly right skewed data modeling, which links a normal distribution to a GPD via an exponential distribution that bridges the gap between mean and asymptotic behaviors. The three distributions are connected to each other at two junction points, denoted by u_1 and u_2. The hybrid probability density function (pdf) is then defined by

$$h(x;\theta) = \begin{cases} \gamma_1 f(x;\mu,\sigma), & \text{if} \quad x \leq u_1 \\ \gamma_2 e(x;\lambda), & \text{if} \quad u_1 \leq x \leq u_2, \quad x \in \mathbb{R} \\ \gamma_3 g(x-u_2;\xi,\beta), & \text{if} \quad x > u_2, \end{cases}$$

where θ denotes the parameters vector and γ_i, $i = 1, 2, 3$, are the weights. The functions f, e and g, represent the Gaussian pdf with mean μ and standard deviation σ, the exponential pdf with intensity λ and the GPD one with tail index ξ and scale parameter β, respectively. We assume a condition of class $\mathcal{C}^1$ to ensure the regularity of h. We develop an unsupervised algorithm for estimating the parameters vector θ of the hybrid model, providing a judicious weighting of the three distributions as well as a good location for the junction points or thresholds, especially for u_2 that points out the presence of extremes. This algorithm is an extension from the one built in Debbabi et al. (2014). It is iterative, and for each iteration is based on the resolution of numerical optimisation problems in least squares sense, using the Levenberg Marquardt (LM) method. The convergence of the algorithm can be proved. The effectiveness of our hybrid model is studied in terms of goodness-of-fit on simulated and real data, considering the *S&P500* absolute log-returns and also the Danish fire insurance claims. A comparison with other more standard approaches follows. This is a joint work with Marie Kratz.

Paul Embrechts

Topics in Quantitative Risk Management

Mon-Wed-Fri 12:00 – 13:00 INVITED COURSE

In this short series of lectures I will discuss some topics from the realm of Quantitative Risk Management (see the book under this title co-authored with A.J. McNeil and R. Frey, Princeton University Press, 2005, 2015 (Sec. Revised Ed.)). I will also aim at making a link to recent research such as Risk Aggregation under Model Uncertainty and Quantile-based Risk Allocation.

Mikael Escobar-Bach

An asymptotically unbiased and robust estimator of the stable tail dependence function

Thu 16:00 – 17:30 POSTER

Modeling dependence among variables is a challenging topic in multivariate extreme value theory. For instance, in the case of environmental data, it can be of interest to link still water levels and wave heights in order to avoid flooding, whereas in finance measuring the dependence between risky asset returns can be crucial. The well-known Pearson correlation coefficient is not an appropriate measure of dependence in this context since it is only valid in case of linear association and it gives the same weight to all the observations. Alternative dependence measures have thus been introduced in the recent extreme value literature, among them we can mention the coefficient of tail dependence, the spectral distribution function or the Pickands dependence function. In this talk, we focus on the stable tail dependence function, firstly introduced by Huang (1992). However, in practical data analysis, it can also happen that observations are contaminated in the sense that some outliers may have a disturbing effect on the usual estimators. Consequently, it is important to propose robust estimators which also keep the nice property of being asymptotically unbiased as those proposed by Fougères *et al.* (2015) and Beirlant *et al.* (2015). In order to solve this issue, we use the minimum density power divergence (MDPD) criterion introduced by Basu *et al.* (1998) to construct a robust and asymptotically unbiased estimator. In this talk, we establish its asymptotic behaviour under suitable assumptions and illustrate its finite sample performance by means of an extensive simulation study compared to the empirical estimator. This is a joint work with Y. Goegebeur, A. Guillou, and A. You.

Isabel Fraga Alvez

Tailoring heavy tails for a truncated scenario

Mon 11:30 – 12:00 TALK

The Pareto tailed models are widely used for assessing the risk of rare events in several fields, as large losses in insurance, size distributions of wild forest fires, large river flows with implications to flooding in hydrology and so many others. Although these power tails reveal a very large applicability to fit heavy-tailed phenomena, in practice natural upper bounds can appear that truncate the probability tail, such as the Maximum Possible Loss in insurance treaties or as river flows measurements in a floods scenario; in other situations, it may also be advisable to apply an upper truncation, ensuring the existence of power moments of the distribution of interest, as to obtain reasonable estimated large loss amounts in insurance. At other instances ultimately at the largest data, deviations from a Pareto tail behaviour become apparent. Along the process of tailoring these heavy tails to truncated Pareto-type distributions, the main features of characteristics of interest in the former are somehow kept, under a *light truncation* scenario. Given that in practice one does not always know whether the distribution is truncated or not, we consider estimators for extreme quantiles, useful for truncated and non-truncated Pareto-type distributions. The estimator of the tail index for the truncated Pareto distribution proposed in Aban *et al.* (2006) is used under this truncated Pareto type setup. We also propose a truncated Pareto QQ-plot and a formal test for truncation in order to help deciding between a truncated and a non-truncated case. In this way we enlarge the possibilities of extreme value modelling using Pareto tails, offering an alternative scenario by adding a truncation point T that is large with respect to the available data. In the mathematical modelling we hence let $T \to \infty$ at different speeds compared to the limiting fraction ($k/n \to 0$) of data used in the extreme value estimation. The method leads to quantile estimators which are especially effective in the case of *rough truncation*. Moreover, an estimator for extremal quantiles of the underlying non-truncated Pa-type distribution is also proposed for situations when this is relevant.
This is a joint work with Jan Beirlant (KU Leuven) and Ivette Gomes (Lisbon University).

Zied Gara

Operational risk, a risk from high risks: modelling catastrophic operational loss events using a compound Neyman-Scott cluster model

Tue 16:00 – 17:30 POSTER

A sound operational risk quantification framework needs to repose on a fair understanding of the machinery of catastrophic operational loss events. Though, understanding the real laws governing such a type of events may be extremely challenging. Nonetheless, we propose the following two-level risk generation mechanism that could mimic to a certain extent the perceived reality: in the first level, there is the occurrence of natural and man-made catastrophes; in the second level, there is the occurrence of extreme operational loss events, which are triggered through time by the arrival of those catastrophes. This mechanism could be prone to generating such loss events in the form of clusters throughout time. Those events may be of the seven event types categorized by the Basel Committee (BCBS, 2006). In agreement with that physical description, we propose to model the arrival of those events by a Neyman-Scott cluster process. In essence, this is a two-level stochastic process, where in the first level the cluster centres (actually natural and man-made catastrophes) occur and trigger, in the second level, the cluster members (actually the severe loss events), which arrive clustered over time. The overall cluster point process is then formed by the superposition of all the cluster members triggered by all the cluster centres. Next, upon adhering to the standard Loss Distribution Approach framework, we present the aggregate loss process as a compound Neyman-Scott process. More precisely, this compound model is governed by a Neyman-Scott process for the event occurrences and a generalized Pareto distribution (GPD) for the high severity of events. We fit the compound model to a series of loss events (selected from the database WORLD). The model possesses five parameters, two pertaining to the GPD and three to the Neyman-Scott process. The GPD parameters are estimated using the maximum likelihood method (McNeil et al., 2005, chap. 7), whereas the Neyman-Scott model parameters are estimated using a nonlinear least squares technique (Madsen et al., 2004). Worth highlighting the actual Neyman-Scott process was originally developed and applied by Kavvas and Delleur (1975) to model rainfall occurrences. We also conduct a simulation study to simulate, on the one hand, synthetic events from the Neyman-Scott process and to quantify, on the other hand, the actual operational risk exposure.

Yi-Ariel Gu

'Specialist' versus 'Generalist': mutual fund performance and manager lifetime work experience

Mon 16:00 – 17:30 POSTER

Individuals' past working experience is considered as an essential determinant that shapes their current career performance. The skills and knowledge acquired from the prior working experience may be transferred to the current working context, thereby influencing the current job performance (Schmidt, Hunter, & Outerbridge, 1986). Researchers have explored this topic from the perspectives of both applied psychology and empirical finance analysis, where the latter particularly pertains to the CEO behaviour analysis (Custdio, Ferreira, & Matos, 2013). Building on this literature, we investigate the relation between mutual fund managers past experience and mutual fund performance. The existing literature on the determinants of mutual fund performance focuses either on the role of (i) fund characteristics, such as fund flows and fund size (Hu, Kale, Pagani, & Subramanian, 2011; Pollet & Wilson, 2008) or (ii) managerial traits, such as the manager's education background and gender (Atkinson, Baird, & Frye, 2003; Chevalier & Ellison, 1999). Using innovative data on U.S. mutual fund managers work experience ranging from 1993 to 2012, we extend the mutual fund performance literature by investigating whether the mutual fund performance relates to accumulated managerial experience acquired during the career of the fund manager. To measure the experience generality of each manager, we construct a Managerial Experience Index (MEI) based on 3 professional experience factors from the past career history of that manager: (i) investment objectives of the funds that s/he has managed (Zambrana & Zapatero, 2015), (ii) fund companies that s/he has worked for and (iii) industries of stocks in which s/he has invested (Kacperczyk, Sialm, & Zheng, 2005). The MEI would increase along with the experience accumulation for each mutual fund manager. We define the 'Specialist' manager as someone with MEI exceeding the annual median MEI, and the 'Generalist' as someone with MEI below the annual median. Therefore, the 'Specialist' refers to portfolio managers with more concentrated professional history while the 'Generalist' refers to those with more diversified experiences. We find that 'Specialist' managers outperform 'Generalist' managers, before and after adjusting for fund fees based on Carhart 4 factor (Carhart, 1997) and Fama-French 5 factor (Fama & French, 2015) models. The negative relation between the MEI and mutual fund returns is robust to controlling for fund load, fund age, fund size and turnover ratio. We also find that the 'Specialist' tends to exhibit the stock-picking ability while the 'Generalist' tends to exhibit the market-timing and industry-timing ability. Our study represents a new method to evaluate the mutual fund performance from the perspective of managers lifetime working experience.

Junyi Guo

Portfolio selection and risk control for an insurer in the Levy market under mean-variance criterion

Tue 17:30 – 18:00 TALK

In this paper, the martingale approach is applied to study the optimal investment and risk regulation problem for an insurer. Assume that the insurer is allowed to invest in a financial market consisting of one risk-free asset and one risky asset whose price follows a Levy process. The risk process is described by another Levy process, and the insurer can regulate the risk by controlling the number of insurance polices. Closed-form expressions for the optimal strategies and the effcient frontier are obtained under the criterion of mean-variance.

Fima Klebaner

Limits for the age structure of a population for large carrying capacity

Wed 9:00 – 10:00 KEYNOTE SPEECH

We consider a family of general branching processes whose reproduction parameters may depend on the age of the individual as well as the whole age structure of the population, as well as carrying capacity K. Such processes are easier to analyze if seen as measure-valued ages. We establish the law of large numbers with a non-random limit that solves McKendrick-von Foerster equation. Then show that a suitably normalized process satisfies Central Limit Theorem with a distribution-valued limit, which satisfies a stochastic PDE.
This is joint work with Jie Yen Fan, Kais Hamza (Monash) and Peter Jagers (Gothenburg).

Tomasz J. Kozubowski

Certain stochastic models connected with random sums and maxima

Fri 10:30 – 11:00 TALK

We present recent results concerning stochastic models for (X,Y,N), where X and Y, respectively, are the sum and the maximum of N components dependent by mixture. Models with this or similar structure are desirable in many applications, ranging from hydro-climatology, to finance and insurance. Our construction with random N is built upon a pivotal model described in [**?**], involving a deterministic number of IID exponential variables, where the basic characteristics of the involved multivariate distributions admit explicit forms. Theoretical results will be accompanied by real data examples, illustrating the applicability of these models.

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Marie Kratz

On risk concentration under 2nd order MRV

Mon 18:00 – 18:30 Talk

We study the behavior of extreme quantiles of the finite sum of heavy-tailed random variables, under multivariate second order regular variation condition. Looking at the literature, asymptotic (for high threshold) results have been obtained, one one hand when assuming (asymptotic) independence and second order regularly varying conditions on the variables, on the other hand when considering specific copula structures. We show that many models used in practice come under the purview of our assumption and provide a few examples. Moreover this ties up related results available in the literature under a broad umbrella. We deduce asymptotic risk concentration results. This is a joint work with Bikramjit Das (SUTD).

Annika Krutto

Estimation in Univariate Stable Laws

Thu 16:00 – 17:30 POSTER

The four-parameter stable laws arise as the only limiting distributions in a random normalized summation scheme. They allow skewness and heavy tails and are proposed as models for various processes in physics, finance and elsewhere. The deficiency of closed form for density of stable laws severely complicates the estimation of stable parameters. A number of techniques are based on the empirical characteristic function. One of the most studied of such procedures is the iterative weighted regression (Koutravelis,1985) simplified by Kogon and Williams (1998). Another well known approach is the minimum distance estimation method (Paulson et al.,1975). The motivation for this study arises from a procedure known as the method of moments (Press, 1972). The method yields explicit point estimators for all parameters, but leaves unresolved the problem that these estimates depend on an arbitrary choice of the two pairs of arguments of empirical char- acteristic function. The performance of the method of moments (e.g., Fan, 2006) and the choice of arguments (e.g., Höpfner and Rüschendorf, 1999) has been concerned for some special cases of stable laws with few simulation results. Albeit, the optimal selection of the pairs of arguments still is an open question (Borak et al., 2005) as well as the efficiency of the method requires more elaborated study. Press (1972) adds that it needs further in- vestigation if his method could be used at the same pair arguments. In our study we show that the method of moments can be applied at one pair of arguments only. To assess the effectiveness of the method of moments we carry out extensive simulation experiments over the entire parameter space at different selections of pairs of arguments. Following that we introduce and meticulously present the simulation results to a more fruitful version of the method of moments, called a reduced values cumulant estimates. In addition we illustrate the performance of reduced values cumulant estimates with an application to non-life insurance claims. It is well known that claims in an insurance portfolio are not normally distributed whilst are heavy-tailed and right-skewed. For comparison we apply other common procedures for estimating the stable parameters, such as the maximum likelihood estimates (Nolan, 2001), the quantile based estimates (McCulloch, 1986) and characteristic function based estimates (Kogon and Williams,1998). Comparing with other methods the reduced values cumulant estimates give the best fit to the non-life insurance claims in our example.

Jean Lemaire

La Baule - Birthplace of Bonus-Malus theory.
Current challenges for Bonus-Malus systems

Mon 9:30 – 10:30 INVITED TALK

ASTIN legend states that, when General de Gaulle was elected President of the 5th Republic in December 1958, he instructed French insurance companies to start using bonus-malus systems (BMS). French actuaries, needing all the help they could get, then convened the first ASTIN Colloquium in La Baule in June 1959. Is there any truth to that story? A review of the papers presented in La Baule provides the answer to this historical actuarial mystery.

After enjoying more than fifty years as a cornerstone of motor insurance rating, will BMS become less important, or even fade away? The main goals of BMS rating are (a) to induce policyholders to drive more carefully; (b) a response to adverse selection and driver characteristics not revealed to the insurer; and (c) a technique to sequentially estimate the claim frequency of policyholders. With hard national BMS being replaced by softer company systems that often forgive the first claim, the inducement to drive better is weakened; telematics may provide a priori driver behavior that BMS only reveal a posteriori; and with the low claim frequencies observed nowadays, the sequential estimation of claim frequencies is abysmally slow. We review all applications of a model by Taylor that jointly incorporates traditional rating variables and BMS to start a discussion on these questions.

Jacques Levy Vehel

A conditional equity risk model for regulatory assessment

Tue 18:00 – 18:30 Talk

We define and study in this work a simple model allowing for a prudential valuation of solvency capital requirement while avoiding over-assessment specifically after market disruption. The main idea is to include a dampener component in charge of refining risk assessment after a market failure. Rather than aiming at a realistic, and thus complex, description of equity prices movements, our model concentrates on minimal features enabling accurate computation of regulatory capital requirements. The model is defined both in a discrete and continuous fashion. In the latter case, we prove the existence, uniqueness and stability of the solution of the stochastic functional differential equation that specifies the model.

One difficulty is that the proposed underlying stochastic process has neither stationary nor independent increments. We are however able to perform statistical analyses in view of its validation. Numerical experiments show that our model outperforms more elaborate ones of common use as far as medium term (between 6 months and 5 years) risk assessment is concerned. We believe that our approach offers an attractive alternative for insurance and reinsurance companies to assess their 1 year equity-risk solvency capital requirement with an internal model and their ORSA capital.

Ronnie Loeffen

On a class of time inhomogeneous affine processes

Tue 10:30 – 11:00 TALK

One-dimensional, positive, affine processes are well-studied and have been applied to e.g. interest rate, credit risk and stochastic mortality modelling. Here we consider a slightly more general class by including a time inhomogeneity component. We present a new technique for computing the Laplace transform which has some advantages over the standard method consisting of computing the generalised Riccati equations. We also show why the class is richer than the time homogeneous one by looking at shapes of yield curves in short rate models.
This is joint work with Ziquan Zhang (University of Manchester).
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Sooie-Hoe Loke

Ruin Probability with Delayed Claims and Risky Investments

Thu 10:30 – 11:00 TALK

The notion of incurred but not reported (IBNR) claims is modeled by delaying the settlement of each claim by a random time. When the investment process of the insurance company follows a geometric Brownian motion, a parabolic integro-partial-differential equation (IPDE) is derived for the ultimate ruin probability with final value condition given by the ruin probability under risky investments with no delay. Assuming that the delay times are bounded by a constant, an existence theorem of the final value IPDE in the space of bounded functions, and a uniqueness theorem in the space of square integrable functions, are obtained. When the delay times are deterministic, it is shown that delaying the settlement of claims does not reduce the probability of ruin when the volatility is large. When the claim sizes are exponential distributed, Laplace transform is used to study the ruin probability under small volatility.

Krishanu Maulik

Extremes of Multi-Type Branching Random Walk: Heaviest Tail Wins

Thu 17:30 – 18:00 TALK

Branching random walk is a very important model with wide applications in Probability and Statistical Physics The model was introduced by Hammersley (1974), Kingman (1975) and Biggins (1976), who considered the asymptotic behaviour of the scaled extremum of the branching random walk. Durrett (1979, 1983) considered the same problem when the displacements are heavy tailed. Brunet and Derrida (2011) considered the walk as a whole, namely as a point process. They conjectured the walk with suitable scaled points to have a non-degenerate limit with a particular structure, which they called a *decorated point process decorated by another point process*. Madaule (2015) proved the conjecture when the displacements have exponentially decaying tails, and Bhattacharya et al. (2016) when the displacements are heavy-tailed. They did not require the displacements to be independent, but allowed the displacements of a particle in a generation to be multivariate regularly varying. However, in all these articles, there were only one type of particles and hence all the displacements have same distribution. We extend the results in the heavy-tailed setup for multitype branching random walk, when the distribution of the displacement depends on the type of the offspring. We consider a branching process with finitely many Q types of offsprings. We assume that the process satisfies the generalized Kesten-Stigum conditions. In particular, the mean offspring matrix $\boldsymbol{M}$ is defined and is positive regular. We also assume the q-th type offspring of p-th type particle $Z^{(p)}(q)$ satisfies $E[Z^{(p)}(q)\log Z^{(p)}(q)] < \infty$ for all p, q. Given the genealogical tree $\mathbb{T}$, each particle in $\mathbb{T}$ associates, with its offsprings, an independent copy of $(\boldsymbol{X}^{(1)},\ldots,\boldsymbol{X}^{(Q)})$, where $\boldsymbol{X}^{(q)} = (X_1^{(q)}, X_2^{(q)},\ldots)$ and $X_i^{(q)}$ denotes the random displacement of the i-th offspring of q-th type. We assume that the displacements corresponding to each type of offspring have same marginal distribution and that of the Q-th type offspring has the heaviest tail. The displacement vector of the Q-th type offsprings of a particle need not be independent, we assume them to have regular variation in the space $\mathbb{R}^{\mathbb{N}} \setminus \{\mathbf{0}\}$. Given a vertex $\boldsymbol{v}$ in the tree $\mathbb{T}$, let $I_{\boldsymbol{v}}$ denote the path from the root to the vertex $\boldsymbol{v}$ and for each particle $\boldsymbol{w}$, let $X_{\boldsymbol{w}}$ denote the displacement associated with the particle, when it was born. Then the position of the vertex $\boldsymbol{v}$ is given by $S_{\boldsymbol{v}} = \sum_{\boldsymbol{w}\in I_{\boldsymbol{v}}} X_{\boldsymbol{w}}$. The branching random walk will be the collection of the positions of the vertices given by $\sum_{\boldsymbol{v}\in\mathbb{T}} \delta_{S_{\boldsymbol{v}}}$. We further denote $|\boldsymbol{v}|$ to be the generation of the vertex $\boldsymbol{v}$ in the genealogical tree $\mathbb{T}$. We shall consider the point process $N_n = \sum_{|\boldsymbol{v}|=n} \delta_{b_n^{-1}S_{\boldsymbol{v}}}$, for an appropriate scaling sequence $\{b_n\}$ obtained from the limiting measure λ. The point process N_n belongs to the space $\mathcal{M}$ of Radon point measures on $[-\infty,\infty]\setminus\{0\}$. We shall show that N_n converges weakly to a Cox cluster process in $\mathcal{M}$ endowed with the topology of vague convergence. The limit is a strictly α-stable point process; it can also be viewed as a randomly scaled, scale decorated Poisson point process, as conjectured by Brunet and Derrida (2011). Joint work with A. Bhattacharya, Z. Palmowski, P. Roy.

Alexander McNeil

Backtesting Trading Book Models with Realized p-Values

Fri 11:30 – 12:00 TALK

The outcome of the 'Fundamental Review of the Trading Book' is that the capital requirement for banks using an internal model approach for their trading books will be based on the expected shortfall (ES) risk measure. However, the process of gaining internal model approval will continue to be based on backtesting value-at-risk (VaR) estimates at the 99% level and the approval process will be extended to individual trading desk level; desks that submit unsatisfactory backtest results may lose internal model approval. The Basel documentation also suggests that banks will be expected to go beyond the basic backtesting requirements by considering VaR exceptions at multiple confidence levels and tests based on so-called realized p-values.
In this talk we will look at an overarching approach to backtesting using realized p-values that subsumes VaR exceptions tests at one or more levels. We will also propose some new tests based on realized p-values that are powerful at detecting models with poor unconditional coverage (too many VaR exceptions) and poor conditional coverage (clustered VaR exceptions).

Weihong Ni

Bonus-Malus with Deductibles

Mon 10:30 – 11:00 TALK

In practice, insurance companies offer policies with deductibles so that small claims could be dealt with by policyholders themselves and the insurer only needs to pay claims that are over a certain threshold. This reduces a considerable number of administrative matters. In this paper, per claim deductibles are considered in a Bonus-Malus system where premiums are dynamically adjusted by the Bayesian approach. By separating the claim frequency and severity components, we add the deductible effect on the latter part first, i.e., only incorporating claims that cost more than the relevant deductibles. Then the claim frequency segment could be estimated after a deduction of such claims. Premiums are computed based on the Net Premium principle. Furthermore, we analysed the asymptotic efficiency of our proposed Bayesian estimators as well as comparing them with the Maximum Likelihood Estimators (MLE). At some extent, such analysis would help with the Bonus-Hunger issue associated with a Bonus-Malus system.

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John Nolan

Semi-parametric estimation for multivariate extreme value distributions

Fri 9:00 – 10:00 KEYNOTE SPEECH

We present estimation methods for multivariate extreme value distributions using max projections. The procedure requires tools from computational geometry and multivariate integration techniques. An R package mevd is being developed to implement the method for several semi-parametric classes of multivariate EVDs: discrete angular measure, generalized logistic, piecewise constant and linear angular measures, and Dirichlet mixture models. This is a joint work with Anne-Laure Fougeres and Cécile Mercadier.

Keita Owari

On Convex Functions on Orlicz Spaces with Δ_2-Conjugates

Tue 09:30 – 10:00 TALK

We show that in an Orlicz space L^Φ with the conjugate Young function Ψ being Δ_2 (so L^Φ is the dual of L^Ψ), a proper convex function has a $\langle L^\Phi, L^\Psi\rangle$-dual representation iff it is order lower semicontinuous; more precisely, a convex set $C \subset L^\Phi$ is $\sigma(L^\Phi, L^\Psi)$-closed iff for each order interval $[-\eta, \eta] = \{\xi : -\eta \leq \xi \leq \eta\}$ $(0 \leq \eta \in L^\Phi)$, the intersection $C \cap [-\eta, \eta]$ is closed in L^0. The result is based on the following technical lemma: for any norm bounded sequence $(\xi_n)_n$ in L^Φ which converges in probability to 0, there exist *forward* convex combinations $\zeta_n \in \mathrm{conv}(\xi_n, \xi_{n+1}, ...)$ as well as an element $\eta \in L^\Phi_+$ such that $\zeta_n \to 0$ and $|\zeta_n| \leq \eta$. We show also that a finite-valued convex function on L^Φ is $\tau(L^\Phi, L^\Psi)$-continuous iff it is sequentially $\tau(L^\Phi, L^\Psi)$-continuous on order intervals, and the condition is equivalent to the order continuity of the function.

Giovanni Pagliardi

Tail relation between return and volume in the US stock market: an analysis based on extreme value theory

Tue 16:00 – 17:30 POSTER

Using daily data of the S&P 500 index from 1950 to 2015, we investigate the relation between return and transaction volume in the statistical distribution tails associated with booms and crashes in the US stock market. We use extreme value theory (peaks-overthreshold method) to study the extreme dependence between the two variables. We show that the extreme correlation between return and volume decreases as we consider larger events in both the left and right distribution tails. From an economic viewpoint, this paper contributes to a better understanding of the activity of market participants during extreme events. Our empirical result is consistent with the economic explanation by Gennotte and Leland (1990) of extreme price movements based on misinterpretation of trades by market participants. This is a joint work with François Longin.

Haoyu Qjan

Finite time ruin probability for shot noise risk processes

Mon 16:00 – 17:30 POSTER

The Cox risk process with shot noise is a special case in modelling the collective insurance risk, in which the average number of claims is a time dependent parameter. In this talk, we model the shot noise of a Cox process as a function which dynamically switches between good and bad events/states. The Seals type integral-differential equation and Laplace Transform will be applied to generate explicit results for the probability of finite-time ruin, under several claims distributions.

Lewis Ramsden

On the Expected Number of Capital Injections in Compliance with Solvency II

Mon 16:00 – 17:30 POSTER

In this paper we adapt the classical risk process to comply with the Solvency II (SII) directive. We consider the Solvency Capital Requirement (SCR) and Minimum Capital Requirement (MCR) constraints in terms of individual modified barriers and capital injections. We derive explicit expressions for the moments of the accumulated capital injections up to the time of insolvency for an insurance firm. We further show that the accumulated capital injections, before insolvency, follows a compound geometric distribution with parameters which are given in terms of risk quantities of the classical Poisson risk model. Finally, in the case where claim amounts are exponentially distributed, we give explicit expressions and numerical results for the aforementioned quantities.

Parthanil Roy

Extreme values for stable random fields indexed by trees

Fri 10:00 – 10:30 Talk

In this work, we investigate the extremal behaviour of left-stationary symmetric α-stable (SαS) random fields indexed by finitely generated free groups. We begin by studying the rate of growth of a sequence of partial maxima obtained by varying the indexing parameter of the field over balls of increasing size. This leads to a dichotomy that depends on the properties of the underlying nonsingular action but is different from SαS random fields indexed by $\mathbb{Z}^d$. An important example is the stable field generated by the canonical action of the free group on its boundary with the measure being Patterson-Sullivan. Even though this nonsingular action is conservative, the maxima sequence of the field grows as fast as the non-conservative case. On the other hand, when the action of the free group is dissipative, we further establish that the scaled extremal point process sequence converges weakly to a randomly thinned cluster Poisson process. This limit is novel and also very different from that in the case of a lattice.

Gennady Samorodnitsky

Multivariate Subexponential Distributions and Their Applications

Mon 17:30 – 18:00 TALK

We propose a new definition of a multivariate subexponential distribution. We compare this definition with the two existing notions of multivariate subexponentiality, and compute the asymptotic behaviour of the ruin probability in the context of an insurance portfolio, when multivariate subexponentiality holds. Previously such results were available only in the case of multivariate regularly varying claims.

Benjamin Schannes

Predictive BMA Algorithm

Tue 16:00 – 17:30 POSTER

In this paper, a BMA approach relying on a Branching Process framework is considered and applied to empirical data pertaining to the 2014 Ebola virus disease outbreak in Guinea. Under this parametric Bayesian paradigm, we first derive required model evidences and investigate the problem of model selection. We then revisit the propagation prediction problem explored by Guttorp and Perlman (2012). The problem of predicting extinction or explosion can be formulated in a BMA testing framework, notably through explicit formulae for the underlying BMA-Factors. This is a joint work with Guillaume Ominetti.

Richard Smith

Climate Extremes: Attributions and Future Projections

Thu 9:00 – 10:00 KEYNOTE SPEECH

Many studies have been published arguing that a variety of extreme climatic events have become either more probable or more extreme as a result of human-induced climate change. The *Fraction of Attributable Risk* (FAR) is one widely used measure to quantify this. However, calculating the FAR relies on comparing climate model runs under both anthropogenic and non-anthropogenic conditions, and this may induce a bias if the climate model runs are not closely aligned with observational data. By combining extreme value theory to estimate the probabilities of extreme events, with a hierarchical models analysis to account for differences among climate models and observational data, we propose estimates of the FAR and of future extreme event probabilities that take account of inter-model and model-observation differences. The method is applied to extreme events associated with the European heatwave of 2003, the Russian heatwave of 2010, and the Texas/Oklahoma heatwave of 2011. We also outline some possible extensions of the methodology. This is joint work with Michael Wehner (Lawrence Berkeley Labs).

Maud Thomas

Predict extreme Influenza epidemics

Wed 10:30 – 11:00 TALK

Influenza viruses are responsible for annual epidemics, causing more than 500,000 deaths per year worldwide. A crucial question for resource planning in public health is to predict the morbidity burden of exceptional or extreme epidemics. A main goal of Extreme Value Theory (EVT) is to assess, from a series of observations, the probability of events that are more extreme than those previously recorded. Our objective is to predict the occurence in the near future of exceptional or extreme influenza epidemics: to predict if in the next couple of weeks an unusual epidemic will occur. ILI (Influenza-like illness) has been shown to be a good proxy for influenza incidence.The ILI case definition consisted of a combination of fever above 39°C, myalgia, and respiratory symptoms. We collected the ILI incidence rates, that is the number of new cases per 100,000 individuals for week t, in France from 1984 to 2016 from the Sentinelles network: approximately 1,500 practicing physicians in France voluntarily participate in disease surveillance through this system. The process described by the ILI incidence rates presents two different behaviours depending on whether it is in an epidemic phase or not. As a first step, we propose a two-state autogressive Markov-switching model for this two-regime behaviour. Consider a sequence of pairs of random variables $(R_t, Y_t), t = 1, \ldots, n$ satisfying the following conditions: $\mathbb{P}\{R_t \mid R_{t-1}, \ldots, R_1, Y_t, \ldots, Y_1\} = \mathbb{P}\{R_t \mid R_{t-1}\}$; $\mathbb{P}\{Y_t \mid R_t, \ldots, R_1, Y_{t-1}, \ldots, Y_1\} = \mathbb{P}\{Y_t \mid R_{t-1}, Y_{t-1}, Y_{t-2}\}$;

- (R_t) is hidden, that is, is not unobervable and assumed to follow a two-state discrete-time Markov chain with .
- Y_t has a different behaviour given R_t

$$
\begin{aligned}
Y_t &= \phi_0^{(0)}(R_t) + \phi_1^{(0)}\left(Y_{t-1} - \phi_0^{(0)}(R_{t-1})\right) + \varepsilon_t \quad \text{if } R_t = 0 \\
Y_t &= \phi_0^{(1)}(R_t) + \phi_1^{(1)}\left(Y_{t-1} - \phi_0^{(1)}(R_{t-1})\right) + \phi_2^{(1)}\left(Y_{t-2} - \phi_0^{(1)}(R_{t-2})\right) + \varepsilon_t \quad \text{if } R_t = 1
\end{aligned}
$$

with $\phi^{(0)}, \phi_0^{(1)}, \phi_1^{(1)}, \phi_2^{(1)} \in \mathbb{R}$ and $(\varepsilon_t), t = 1, \ldots, n$ a sequence of i.i.d. random variables. Thus, we assume that, given $R_t = 0$, Y_t behaves like an first order autogressive process and, given $R_t = 1$, like a second order autogressive process. R_t represents the epidemic regime at week t (0 codes for non-epidemic regime and 1 codes for epidemic regime), and Y_t the ILI incidence rate at week t.
As a second step, we define an epidemic to be extreme if at least one of the following two events occur: some Y_t during the epidemic phase exceeds a (very high) threshold or the sum of the Y_t within the epidemic exceeds a (slightly lower) level. We develop and compare prediction based on the autoregressive switching-Markov model and on the mutlivariate Peaks over Threshold models from Rootzén et al. (2016). This is a joint work with Holger Rootzén.

Charles Tillier

Regular variation for random length sequence of random variables

Thu 16:00 – 17:30 POSTER

Risks evaluation is now a major issue in our society. In dietary risk, hydrology, nuclear security, finance or insurance, for which the risk analysis has become essential, risk theory plays a leading role and is now in the application field of the probability tools and the statistical methods. In this context, most of the stochastic processes can be written from a sequence of random length whose components are random variables. Therefore, during my presentation, I will present you the foundation of regular variations for regularly varying sequences whose length is driven by a random variable in order to develop risk measures. By way of applications, I will suggest risk indicators for a class of processes covered by our framework : the Shot Noise Processes. The goal is to supplement the information given by the most used ones: the ruin probability and the tail process.

Sreekar Vadlamani

CLT for some geometric functionals of excursion sets

Tue 10:00 – 10:30 TALK

Limit theorems for functionals of Gaussian fields has long been of interest. Some striking examples include central limit theorems for the number of crossings and sojourn times for a one dimensional Gaussian process. Lately, researchers have shown interest in extending such results for Gaussian random fields defined on higher dimensional parameter sets. In such a setup, a natural candidate for investigation is the excursion set of the random field. We, in this talk, shall present some recent developments in understanding the distributional aspects of some specific geometric functionals of such excursion sets of Gaussian random field.
This is joint work with Marie Kratz.

Wei Zhu

Various methods to derive explicit ruin probabilities for risk models with Gamma claims

Mon 16:00 – 17:30 POSTER

In risk theory literature, deriving the ruin probability is a central topic. We present three explicit forms of ruin probabilities in classical risk models with Gamma claims. These results are all derived via Laplace transforms of integro-differential equations. The different ways of inverting back the Laplace transform formula give us three infinite series expressions, all involving Mittag-Leffler functions.