

# Research Statement: Dr. Gareth W. Peters

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## Contact Information

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## Research Publication Summary

A basic summary of my research output since 2006 can be found here, with a comprehensive publication record provided in separate document on research publications.

Total Scholarly Books (Author)	2
Total Scholarly Books (Editor)	3
Total Scholarly Book Chapters	5
Total Peer Reviewed Journal Papers Accepted	36
Total Peer Reviewed Conference Papers Accepted	27
Total Current Journal Papers in Review	22
Total Current Conference Papers in Review	10

## Research Focus

My primary research activity is focused on statistical and mathematical modelling of risk, insurance and financial data. Principally, I am a statistician, however, my research focus has been developed in an interdisciplinary fashion, often working with groups with a range of different backgrounds and specialties. Consequently, I currently have publications in topics such as:

- Operational Risk modelling, Basel II/III regulation
- General non-life insurance claims reserving and risk margin
- Financial econometrics: cointegration and vector auto-regressive models; multi-factor models for commodities and calibration; yield curve dynamic multi-factor s.d.e. models; non-linear non-Gaussian state-space models and filtering methods; non-parametric Gaussian process and stable process models for spatial and temporal settings.
- Risk measure approximations and asymptotics
- Rare event and extreme value modelling: capital allocation; rare-event probability modelling; robust estimation in GPD models
- Heavy tailed processes:  $\alpha$ -stable process; sub-exponential models and risk measures; Extreme value theory models
- Dependence Modelling: copula modelling; spectral measure estimation; factor models; concordance measures; tail dependence models
- Catastrophe and extreme events: bonds and trigger analysis; spatial and temporal modelling for spatial exceedences

- Applied Financial Economics: liquidity; liquidity resilience; currency carry trades and uncovered interest rate parity; representative agent based models; best execution; Risk waterfalls for clearing house regulation
- Applied statistical modelling: data analysis with big data such as Limit Order Book level 2 data for electronic exchanges: models of LOB dynamics and estimation of stochastic features; functional regression for liquidity; currency carry trade strategies; pairs trading via co-integration in futures markets; carry trades on futures curves.

As observed above by the list of topics mentioned, the research I have chosen to study in the pursuit of modelling in risk, insurance and financial modelling has included contributions in multiple disciplines.

From the perspective of statistical modelling and methodology, my research has covered theoretical aspects of mathematical statistics and applied probability, methodological aspects of statistical modelling and inference and computational aspects of statistical modelling, though my primary interest lies in methodology and application domains. From a statistical perspective, I have made several contributions to statistical estimation methods in Bayesian methodology and estimation including the topic areas:

- Sampling and Markov chains: Markov chain Monte Carlo; Adaptive Markov chain Monte Carlo; Trans-dimensional Markov chain Monte Carlo; Sequential Markov chain Monte Carlo; Auxiliary variable methods; Forward projection Markov chain Monte Carlo for o.d.e. calibration
- Filtering and Dynamic models: Kalman Filter; Extended Kalman Filter, Uncentered Kalman Filter; Sequential Monte Carlo; Sequential Monte Carlo Samplers; Partial Rejection Control; Path-Space Importance Sampling
- Simulation based likelihood and Bayesian methods: Indirect Inference; multi-objective optimisation; Approximate Bayesian Computation.
- Spatial field modelling, spatial exceedence modelling and sensor networks.

## Research Group Activities

The following is a brief overview of my research program developments to date. This is then followed by my current 5 year research plan.

- Theme leader and founder in 2012 of the research group “Financial Risk, Insurance, Econometrics and Stochastic Finance” in the Department of Statistical Sciences, University College London.
  - Currently an active research program in Operational Risk, Insurance and Financial risk modelling.
  - 10 active permanent UCL academics as members;
  - 9 active international associated research fellows;
  - 8 active research PhD students in the research theme.
- As part of the activities of this group have included:
  - A 2 semester reading group on Levy processes (elements of the books: Cont and Tankov, Appelbaum and Satoh);
  - A London University Taught Courses series special year long PhD level course, jointly taught by myself and Dr. Andrea Macrina (UCL mathematics) on ruin theory;
  - UCL Operational Risk Workshop Series: I co-organized a monthly academic and industry practitioner working group and workshop session with 3 seminar talks per session and topic based discussions.

- Established Quantitative Risk Solutions Laboratory **QRSLab** as joint group between the statistics department of University of New South Wales and the Department of Statistical Sciences in University College London. This is a joint venture with several academic and industrial risk professionals and quantitative analysts. Its agenda is to develop novel methodological research solutions for practical risk modelling scenarios.  
[http://www.homepages.ucl.ac.uk/~ucakgwp/GWP/Gareth\\_Peters.html](http://www.homepages.ucl.ac.uk/~ucakgwp/GWP/Gareth_Peters.html)
- *Coauthor of two recent books in the Wiley Handbooks in Financial Engineering and Econometrics series:*
  1. **“Fundamental Aspects of Operational Risk and Insurance Analytics: A Handbook of Operational Risk.” (Volume 1)**
  2. **“Advances in Heavy Tailed Risk Modelling: A Handbook of Operational Risk.” (Volume 2)**
- Actively involved in industry projects:
  - Awarded 2014/2015: ORX Operational Risk year long projects by ORX banking consortium board (competitive bid process): project topics include risk sensitivity and stress testing frameworks under Basel II/III; Heavy tailed loss modelling; estimation and model selection.
  - Currency carry trade strategies for hedge fund in London: Molinero Capital (2 years)
  - Cointegration pairs trading algorithmic strategies for hedge fund Sydney: ongoing for 8 years.
  - Oasis Insurance Network - training session on system design completed, to join the financial modelling working group.

## Research 5+ year plan

My main areas of interest for the next few years of research development are involved in statistical modelling of Risk and Insurance: Operational Risk; Insurance (catastrophe bonds, non-life insurance claims reserving); Clearing house regulation and financial exchange regulation; capital modelling, risk margin and allocation; spatial catastrophe models and sensor networks for calibration and simulation of seismic events. In addition, I will continue my research on financial econometrics, extending my existing projects on commodity future models, cointegration models and carry trade models.

The main areas of research focus from a statistical perspective involve continuing to develop Monte Carlo sampling and estimation methods to tackle settings such as: multivariate quantile regressions with heavy tailed quantile processes; spatial and temporal exceedence modelling; Gaussian process and Stable process modelling for heavy tailed processes; Levy processes and copula. This will involve, development of novel methodology for sampling, integral estimation and filtering in stochastic models. Development of algorithms (Markov chain Monte Carlo MCMC, Adaptive MCMC, Trans-dimensional MCMC, Sequential Monte Carlo (SMC), non-linear filtering, ABC and Likelihood-free sampling methodology, Annealing and tempering, rare-event simulation).

- Since, my research is inherently driven by real world practical industry projects and problems. I aim to continue to develop strong links with existing and new industry partners. This will facilitate relevant research focus on academic and industry needs, as well as providing data and placements for PhD and MSc students.