8. ACTUARIAL SCIENCE & MATHEMATICAL FINANCE

Programmeme director: Prof. dr. ir. M.H. Vellekoop
Section: Quantitative Economics
JEL-classification: C, G2
Starting date: 1989
Website: www.aseri.uva.nl/act

8.1 MEMBERS OF THE RESEARCH GROUP AND RESEARCH IN FTES

Name	Title	Function	Total 2014	Total 2015	Total 2016	Funding
Antonio, K.	dr.	ud	0,38	0,10	0,10	1
Berkum, F. van	msc	phd	0,32	0,32	0,24	3
Bilsen, S. van	dr.	ud	-	0,08	0,25	1
Bilsen, S. van	dr.	ud	-	0,10	0,30	3
Boonen, T.	dr.	ud	-	0,25	0,50	1
Boonen, T.	dr.	ud	0,00	0,25	-	3
Can, U.	dr.	postdoc	0,50	-	-	1
Can, U.	dr.	ud	-	0,50	0,50	1
Doff, R.R.	dr.	guest	0,00	0,00	0,00	1
Engel, K.	msc	guest	0,00	0,00	0,00	1
Fan, Z.	msc	phd	0,80	0,80	0,80	3
Gastel, L. van	dr.	ud	0,11	0,11	0,11	3
Goovaerts, M.J.	prof. dr.	guest	0,00	0,00	0,00	1
Hooijsma, J.	msc	phd	0,40	0,40	0,40	3
Janssen, M.J.J.	drs.	guest	0,00	0,00	-	1
Kaas, R.	prof. dr.	hgl	0,42	-	-	1
Kaas, R.	prof. dr.	guest	-	0,00	-	1
Kloek, T.G.	msc	guest	-	0,00	0,00	1
Kort, J. de	msc	phd	0,40	0,40	-	3
Kuné, J.B.	prof. dr.	guest	0,00	0,00	0,00	1
Laeven, R.	prof. dr.	hgl	0,80	0,70	0,70	3
Lalu, A.	msc	phd	0,80	0,40	-	1
Li, Z.	msc	phd	-	0,27	0,80	1
Linders, D.	dr.	postdoc	-	0,12	0,23	3
Petrov, M.	msc	guest	0,00	0,00	0,00	1
Plat, H.J.	drs.	guest	0,00	-	-	1
Ronner, A.E.	prof. dr.	bijz. hgl	0,10	0,10	0,10	1
Vellekoop, M.	prof. dr.	hgl	0,35	0,35	0,50	1
Vellekoop, M.	prof. dr.	hgl	0,30	0,30	-	3
Yang, X.	dr.	postdoc	0,27	0,53	-	3
Yue, Y.	msc	phd	0,27	0,80	0,80	3
Total 1st flow of funds			2,17	2,05	2,75	
Total 2nd flow of funds			1,18	0,00	0,00	
Total 3rd flow of funds			2,87	4,83	3,58	
Total 1st f.o.f. excl. Ph.D.'s			1,37	1,38	1,95	
Total 1st-3rd flow of funds			6,22	6,88	6,33	
Ph.D. students			3,04	3,39	3,04	

8.2 PROGRAMME DESIGN

The programme concerns both fundamental and applied research in the field of financial institutions. It is mainly directed at insurance companies (for life, non-life, pension and social insurance), but also at banks and other financial intermediaries. Research is performed on the mathematical modeling, estimation, appraisal and control of financial risks of such financial institutions under complete and incomplete information and for complete and incomplete markets. For long term insurance contracts, especially pensions, saving by insurance is significant, which leads to the study of optimal investment and consumption problems. An increasingly important aspect is the influence of the "risk of longevity" on the policies of life insurance, social insurance and care insurance. Newly reported statistics show that life expectancy continues to rise faster than predicted both in the Netherlands and abroad, and the modeling of this effect and its consequences for life insurance policies and pension contracts therefore remains an important area of investigation. Present-day challenges for non-life insurance contracts include decreasing profit margins, increasing competition and selective behaviour of the insured and of insurance companies. In social insurance, there are specific problems that emerge from the privatisation of social insurance contracts. Apart from studying problems in the separate fields of life, non-life, pension and social insurance, work is also done on the theoretical research subject which concerns the unification of several distinct actuarial theories in these fields, and their connection with stochastic financial mathematics.

Supervision and regulation of insurance companies and pension funds form an important part of the field of actuarial research. Methods for risk measurement and the determination of solvency requirements have come under intensified scrutiny in the wake of the recent financial crisis. The new European regulatory framework Solvency II for insurers and the Dutch FTK regulation for pension funds lead to many important new research questions. The Actuarial Science group therefore works on the further development of actuarial risk theory, in particular the development of new mathematical and economic models in the fields of market-consistent valuation, market-consistent pricing and market-consistent embedded value for insurance portfolios.

Other significant fields of research are the interaction between credibility theory, models for the estimation of unreported claims (IBNR) and actuarial ordering of risks, and their consequences for the determination of insurance premiums (risk classification). Credibility models can be viewed as Generalized Linear Mixed Models, having both random (subject-specific) and fixed effects in the linear predictor. Generalized Linear Models and Generalized Linear Mixed Models can be used for a variety of actuarial statistical problems like survival modelling, graduation, multiple-state models, loss distributions, risk classification, premium rating and claims reserving in non-life-insurance. Other aspects are the homogeneity and heterogeneity of insurance portfolios, the probabilistic and subsidising solidarity imposed on the insured, the voluntary or compulsory character of the insurance, and the auto-selection and anti-selection of those insured.

8.3 PROGRAMME EVALUATION

The year 2016 has been very fruitful for the ASMF research group. Two PhD projects came to a successful conclusion. Jan de Kort finished the writing of his PhD thesis which he will defend in 2017. He has now taken a postdoc position at Tilburg University and he will continue to be affiliated with Netspar. Zhenzhen Fan will also have her PhD defense meeting in the coming year; she has become assistant professor at the School of Finance of Nankai University in Tianjin. But another emeritus professor joined us: prof. Hans Schumacher, who recently retired from his chair at Tilburg University, and prof. Rob Kaas will remain affiliated with our group in the coming year and continue his work as editor of Insurance: Mathematics and Economics.

Student numbers are continuing to increase for the Bachelor programmes and the new Master tracks that our research group is involved in, and as a result there has been some room for growth. The decision to open a new tenure track position led to an extensive international search for actuarial

talent to fill the vacancy. Direct applications were considered but we also organized a series of interviews at the job market in Chicago at the beginning of 2017. Ms. Lu Yang from the University of Wisconsin-Madison has been selected and we are very happy that she will join our group in the coming year. Her PhD thesis concerns copula models for stochastic variables with discrete outcomes, and her research will further strengthen our existing projects in non-life insurance and statistics.

Publications appeared in all the main international journals on Actuarial Science (Insurance: Mathematics and Economics, ASTIN Bulletin, Scandinavian Actuarial Journal and the European Actuarial Journal) but also in Mathematical Finance, the European Journal of Operational research, and the Journal of the American Statistical Association (forthcoming). Topics varied from classical actuarial topics such as optimal risk sharing (Boonen), and stochastic models for human mortality (van Berkum, Antonio) to more finance-oriented subjects such as optimal portfolio theory (Hooijsma), financial contagion (Laeven) and interest rate modelling (de Kort, Vellekoop). Some of these projects are mainly theoretical in nature but others have important policy implications for topical problems in today's society. For pension funds research, we continue to work with Netspar, the Network for studies on Pensions, Ageing and Retirement. The PhD thesis of Servaas van Bilsen made it to the shortlist of the Netspar PhD Thesis Awards and he plays an important and visible role in the discussions about pension system reform in the Netherlands. The appointment of Roger Laeven as a Selected Academic Member of the Insurance and Reinsurance Stakeholder Group (IRSG) of the European Insurance and Occupational Pensions Authority (EIOPA) means that he will help shaping the international debate about regulatory rules for insurance companies. On a national level, the yearly Mini Symposium on Insurance Regulation and Supervision Around the World, which was held at the Koninklijk Instituut voor de Tropen this year, ensures that our group stays connected to the corresponding debate in the Netherlands as well.

Strengths: Our tenure tracks have strengthened the research profile of the group. We therefore expect to continue to play an important role in the national and international research networks which study problems in actuarial science and mathematical finance.

Weaknesses: The group has many junior researchers and only a few senior researchers. The number of part-time positions in the group has decreased, but is still large.

Opportunities: Research in the group comprises some traditional actuarial subjects but also looks at the interplay between finance and insurance. This allows the group to play a growing role in Macro Finance Risk, the research priority area of the faculty. Our statistical expertise makes us a natural partner for other academics ánd professionals who are intensifying their use of data science.

Threats: The success of attracting more students puts extra pressure on staff due to an increase in teaching duties, and especially on the supervison of Bachelor and Master theses.

8.4 RESOURCES AND FUNDING

2012 -: Sponsored PhD Research Grant, APG (Position of Zhenzhen Fan, extended).
2013- : Sponsored PhD Research Grant, Van Ameyde (Position of Yuan Yue).
2013- : EDEEM PhD Research Grant, jointly with Universidade Nova de Lisboa (Position of Marko Petrov).
2017-2021: Sponsoring of new research project "Risk and Regulation" (in the chair of Risk and Insurance), Verbond van Verzekeraars.

8.5 OUTPUT

Key publications

Aït-Sahalia, Yacine, Julio A. Cacho-Diaz & Roger J. A. Laeven (2015). Modeling financial contagion using mutually exciting jump processes, Journal of Financial Economics 117, 585-606.

Antonio, K., & Plat, R. (2014). Micro-level stochastic loss reserving for general insurance. Scandinavian Actuarial Journal 7, 649-699.

Boonen, T. J., Tan, K. S., & Zhuang, S. C. (2016). Pricing in reinsurance bargaining with comonotonic additive utility functions. ASTIN Bulletin, 46(2), 507-530.

Can, S. U., Einmahl, J. H. J., Khmaladze, E. V., & Laeven, R. J. A. (2015). Asymptotically distribution-free goodness-of-fit testing for tail copulas. The Annals of Statistics, 43(2), 878-902.

Chen, A., Pelsser, A. & Vellekoop, M.H. (2011). Modeling Non-Monotone Risk Aversion Using SAHARA Utility Functions, Journal of Economic Theory 146(5), pp. 2075-2092.

Laeven, Roger J. A. & Mitja A. Stadje (2014). Robust portfolio choice and indifference valuation, Mathematics of Operations Research 39, 1109-1141.

Forthcoming

Aït-Sahalia, Yacine, Jianqing Fan, Roger J. A. Laeven, Christina Dan Wang & Xiye Yang (2016). Estimation of the continuous and discontinuous leverage effects, *Journal of the American Statistical Association*.

Boonen, T. J., & De Waegenaere, A. (2017). Intergenerational risk sharing in closing pension funds. Insurance: Mathematics & Economics.

Boonen, T. J. (2017). Risk sharing with expected and dual utility. ASTIN Bulletin.

Boonen, T. J., Tsanakas, A., & Wüthrich, M. (2017). Capital allocation for portfolios with non-linear risk aggregation. Insurance: Mathematics & Economics, 72, 95-106.

Boonen, T. J., De Waegenaere, A., & Norde, H. W. (2017). Redistribution of longevity risk: The effect of heterogeneous mortality beliefs. Insurance: Mathematics & Economics, 72, 175-188.

Boonen, T. J. (2017). Risk redistribution games with dual utilities. ASTIN Bulletin, 47(1), 303-329.

Vellekoop, M. H., & Chen, A. (2017). Optimal investment and consumption when allowing terminal debt. European Journal of Operational Research, 258(1), 385.

Publications in numbers

Output type	Classification	#
Articles in journals	Refereed	11
	Non-refereed	0
	Professional	1
	Popular	0
Books or book chapters	Refereed	0
	Non-refereed	0
	Professional	0
	Popular	0
Conference proceedings		0
PhD theses		0
Total		**12**

Article in journal – refereed

Van Berkum, F., Antonio, K., & Vellekoop, M. (2016). The impact of multiple structural changes on mortality predictions. Scandinavian Actuarial Journal, 2016(7), 581-603.

Boonen, T. J., Tan, K. S., & Zhuang, S. C. (2016). The role of a representative reinsurer in optimal reinsurance. Insurance: Mathematics & Economics, 70, 196-204.

Boonen, T. J. (2016). Nash equilibria of Over-The-Counter bargaining for insurance risk redistributions: the role of a regulator. European Journal of Operational Research, 250(3), 955-965.

Boonen, T. J. (2016). Optimal reinsurance with heterogeneous reference probabilities. Risks, 4(3), [26].

Boonen, T. J., Tan, K. S., & Zhuang, S. C. (2016). Pricing in reinsurance bargaining with comonotonic additive utility functions. ASTIN Bulletin, 46(2), 507-530.

Camlibel, M. K., & Schumacher, J. M. (2016). Linear passive systems and maximal monotone mappings. Mathematical programming, 157(2), 397-420.

De Kort, J., & Vellekoop, M. H. (2016). Existence of optimal consumption strategies in markets with longevity risk. Insurance: Mathematics & Economics, 72, 107-121.

Pazdera, J., Schumacher, J. M., & Werker, B. J. M. (2016). Cooperative Investment in Incomplete Markets under Financial Fairness. Insurance: Mathematics & Economics, 394-406.

Roorda, B., & Schumacher, J. M. (2016). Weakly time consistent concave valuations and their dual representations. Finance and Stochastics, 20, 123-151.

Verbelen, R., Antonio, K., & Claeskens, G. (2016). Multivariate mixtures of Erlangs for density estimation under censoring. Lifetime Data Analysis, 22(3), 429-455.

Zhuang, S. C., Boonen, T. J., Tan, K. S., & Xu, Z. Q. (2016). Optimal insurance in the presence of reinsurance. Scandinavian Actuarial Journal.

Article in journal – professional

Vellekoop, M. H., & Pelsser, A. A. J. (2016). Kansloos en geschokt. Actuaris.