

# Actuarial, Financial and Statistical Aspects of Dependencies in Insurance and Financial Portfolios (GOA 2007/2011)

## *Deel 2: Wetenschappelijke output van het project*

<b>2.1</b>	<b>PUBLICATIES</b>	<b>2</b>
2.1.1	Artikels in internationale gereviewde tijdschriften (IT)	2
2.1.2	Artikels in andere wetenschappelijke tijdschriften (AT)	4
2.1.3	Boeken, als auteur, internationaal georiënteerd (IBa)	4
2.1.4	Boeken, als auteur, andere dan IBa (ABa)	4
2.1.5	Boeken, als editor, internationaal georiënteerd (IBe)	4
2.1.6	Boeken, als editor, andere dan IBa (ABe)	4
2.1.7	Artikels in of gedeelten van boeken, internationaal erkende uitgevers (IHb)	4
2.1.8	Artikels in of gedeelten van boeken, andere wetenschappelijke uitgevers (AHb)	5
2.1.9	Mededelingen op internationale congressen, integraal gepubliceerd in proceedings (IC)	5
2.1.10	Mededelingen op andere congressen, integraal gepubliceerd in proceedings (AC)	5
2.1.11	Thesissen - doctoraat (TH)	5
2.1.12	Interne rapporten, niet elders gepubliceerd (IR)	5
2.1.13	Andere publicaties (DI)	7
<b>2.2</b>	<b>DOCTORANDI</b>	<b>8</b>
<b>2.3</b>	<b>ANDERE ACTIVITEITEN</b>	<b>8</b>
2.3.1	National and international cooperation	8
2.3.2	Composition of the GOA working team	8
2.3.3	International conferences, local seminars, workshops and invited lectures	8
2.3.4	Stays abroad	11
2.3.5	Visiting faculty	11
<b>2.4</b>	<b>ABSTRACTS</b>	<b>12</b>

## 2.1 PUBLICATIES

### 2.1.1 Artikels in internationale gereviewde tijdschriften (IT)

- [GOA] Risk measurement with equivalent utility principles  
M. Denuit, J. Dhaene, M. Goovaerts, R. Kaas, R. Laeven  
Statistics & Decisions, vol. 24(1), 1-25, 2006.
- [GOA] Risk measures and comonotonicity: a review  
J. Dhaene, S. Vanduffel, Q. Tang, M.J. Goovaerts, R. Kaas, D. Vyncke  
Stochastic Models, vol. 22, 573-606, 2006.
- [GOA] On the characterization of premium principles under pointwise comonotonicity  
J. Dhaene, A. Kukush, M. Pupashenko  
Theory of Stochastic Processes, vol. 12 (28), N3-4, 27-45, 2006.
- [GOA] Bounds for the price of a European-style Asian option in a binary tree model  
H. Reynaerts H., M. Vanmaele, J. Dhaene, G. Deelstra  
European Journal of Operational Research, vol. 168(2), 322-332, 2006.
- [GOA] The use of a stochastic LGD in a credit default economic capital framework  
J. Dhaene, S. Vanduffel, M.J. Goovaerts, R. Koch, O. Olieslagers, Romijn  
Journal of Actuarial Practice. Details zijn beschikbaar.
- [GOA] Recursions for the individual model  
J. Dhaene, C. Ribas, R. Vernic  
Acta Mathematica Applicatae Sinica, English Series, vol. 22(4), 631-652, 2006.
- [GOA] Comonotonic bounds on the survival probabilities in the Lee-Carter model for mortality projection  
M. Denuit, J. Dhaene  
Journal of Computational and Applied Mathematics, vol. 203, 169-176, 2007.
- [GOA] Can a coherent risk measure be too subadditive?  
J. Dhaene, R. Laeven, S. Vanduffel, G. Darkiewicz, M.J. Goovaerts  
Journal of Risk and Insurance, accepted for publication.
- [GOA] Optimal approximations for risk measures of sums of lognormals based on conditional expectations  
S. Vanduffel, X. Chen, J. Dhaene, M. Goovaerts, L. Henrard, R. Kaas  
Journal of Computational and Applied Mathematics, accepted for publication.
- [GOA] Some results on the CTE based capital allocation rule  
J. Dhaene, L. Henrard, Z. Landsman, A. Vandendorpe, S. Vanduffel  
Insurance: Mathematics & Economics, accepted for publication.
- [GOA] On the parameterization of the CreditRisk+ model for estimating credit portfolio risk  
A. Vandendorpe, N. Ho, S. Vanduffel, P. Van Dooren  
Insurance: Mathematics and Economics, accepted for publication.
- [GOA] Actuarial statistics with generalized linear mixed models  
K. Antonio, J. Beirlant  
Insurance: Mathematics and Economics 40(1), 58-76, 2007.
- [GOA] Issues in claims reserving and credibility: a semi-parametric approach with mixed models.  
K. Antonio & J. Beirlant  
Journal of Risk and Insurance, accepted for publication.

- [GOA] Pricing credit default swaps under Lévy models  
J. Cariboni, W. Schoutens  
Journal of Computational Finance 10(4), 1-21, 2007.
- [GOA] General lower bounds for arithmetic Asian option prices.  
H. Albrecher, Ph. Mayer, W. Schoutens  
Applied Mathematical Finance, to appear.
- [GOA] A generic one-factor Levy model for pricing synthetic CDOs  
H. Albrecher, S. Ladoucette, W. Schoutens  
Advances in Mathematical Finance, R.J. Elliott et al. (eds.), Birkhaeuser, 2007.
- [GOA] The Little Heston Trap  
H. Albrecher, Ph. Mayer, W. Schoutens, J. Tistaert  
Wilmott Magazine, January Issue, 83-92, 2007.
- [GOA] Self exciting threshold interest rates models. Asymmetric skew Bessel processes and their applications to finance.  
M. Decamps, M. Goovaerts, W. Schoutens  
International Journal of Theoretical and Applied Finance, 9 (7), 1093-1122.
- [GOA] A Multivariate Jump-Driven Financial Asset Model  
E. Luciano, W. Schoutens  
Quantitative Finance 6 (5), 385-402, 2006.
- [GOA] Optimal investement in a Lévy market  
J.M. Corcuera, J. Guerra, D. Nualart, W. Schoutens  
Applied Mathematics and Optimization, 2006.
- [GOA] The Importance of Jumps in Pricing European Options  
F. Campolongo, J. Cariboni, W. Schoutens  
Reliab. Eng. Syst. Saf. 91(10-11), 1148-1154, 2006.
- [GOA] Exotic options under Lévy models: An overview  
W. Schoutens  
Journal of Computational and Applied Mathematic, 189, 526-538, 2006.
- [GOA] Asymmetric skew Bessel processes and their applications to finance.  
M. Decamps, M. Goovaerts, W. Schoutens  
Journal of Computational and Applied Mathematics 186 (1), 130-147, 2006.
- [GOA] Iterates of the infinitesimal generator and space-time harmonic polynomials of a Markov process  
P.M. Barrieu, W. Schoutens  
Journal of Computational and Applied Mathematics, 186 (1), 300-323, 2006.
- [GOA] Actuarial risk measures for financial derivative pricing  
M. Goovaerts, R. Laeven  
Insurance: Mathematics and Economics, accepted for publication (2007)
- [GOA] On Risk Measures and Decisions in Insurance and Finance  
M. Goovaerts, R. Kaas, R. Laeven  
To be published (2007)
- [GOA] Worst case risk measurement: back to the future?  
R. Laeven, M. Goovaerts, R.Kaas  
To be published (2007)

### **2.1.2 Artikels in andere wetenschappelijke tijdschriften (AT)**

- [GOA] Invloed van IFRS en Solvency 2 op het risicobeheer van verzekeringsmaatschappijen  
S. Vanduffel, J. Dhaene, M. Goovaerts  
Bank- en Financieuzen, 5, 2006.
- [GOA] Comonotonicity  
J. Dhaene, S. Vanduffel, M. Goovaerts  
Tijdschrift voor Economie en Management, vol. LII, 265-278, 2007.
- [GOA] Beyond Correlations: The Use and Abuse of Copulas in Economic Capital Calculations  
Chernih, M. Maj, S. Vanduffel (2007)  
Belgian Actuarial Bulletin, accepted for publication.
- [GOA] Decision Principles derived from Risk Measures  
M. Goovaerts, R. Kaas, R. Laeven  
Hermis Vol. 8, pp. 109-124, 2007

### **2.1.3 Boeken, als auteur, internationaal georiënteerd (IBa)**

#### **2.1.4 Boeken, als auteur, andere dan IBa (ABa)**

#### **2.1.5 Boeken, als editor, internationaal georiënteerd (IBe)**

- [GOA] Proceedings of the 'Fourth Actuarial and Financial Mathematics Day (februari, 2006), Royal Flemish Academy of Belgium for Science and Arts, Brussels.  
M. Vanmaele, A. De Schepper, J. Dhaene, H. Reynaerts, W. Schoutens, P. Van Goethem  
2006.

#### **2.1.6 Boeken, als editor, andere dan IBa (ABe)**

#### **2.1.7 Artikels in of gedeelten van boeken, internationaal erkende uitgevers (IHb)**

- [GOA] Comonotonicity  
J. Dhaene, S. Vanduffel, M. Goovaerts  
In: Wiley Encyclopedia of Quantitative Risk Assessment, to be published.
- [GOA] Risk classification in non-life insurance  
K. Antonio & J. Beirlant  
Encyclopedia of Quantitative Risk Assessment -- Insurance/Actuarial Risks Section, Wiley, accepted for publication.
- [GOA] Premium calculations and insurance pricing  
R. Laeven, M. Goovaerts  
Wiley Encyclopedia of Quantitative Risk Assessment, to be published.

### **2.1.8 Artikels in of gedeelten van boeken, andere wetenschappelijke uitgevers (AHb)**

#### **2.1.9 Mededelingen op internationale congressen, integraal gepubliceerd in proceedings (IC)**

- [GOA] Can a coherent risk measure be too subadditive?  
J. Dhaene, R. Laeven, S. Vanduffel, G. Darkiewicz, M.J. Goovaerts  
28th International Congress of Actuaries, AFIR, Paris, May 28 – June 2, 2006.
- [GOA] Static super-replicating strategies for exotic options  
X. Chen, G. Deelstra, J. Dhaene, M. Vanmaele  
4th Conference in Actuarial Science & Finance in Samos, Karlovassi, Greece, September 14-17, 2006.
- [GOA] Economic Capital Aggregation and Disaggregation  
Vandendorpe, S. Vanduffel, M. Lundin  
Eurobanking Congress, Dubrovnik, Croatia, 21-24 May, 2006.
- [GOA] Credit risk portfolio modelling: Estimating the portfolio loss distribution  
L. Hoegaerts, S. Vanduffel  
Eurobanking Congress, Dubrovnik, Croatia, 21-24 May, 2006.
- [GOA] Optimal asset-mix studies in case of stochastic cash-flows  
X. Chen, J. Dhaene, M. Goovaerts, L. Henrard, S. Vanduffel  
11th International Congress on Insurance: Mathematics & Economics, Piraeus, Greece, July 10-12, 2007.
- [GOA] Bounds for sums of dependent log-elliptical random variables.  
M. Maj, E. Valdez, J. Dhaene  
11th International Congress on Insurance: Mathematics & Economics, Piraeus, Greece, July 10-12, 2007.
- [GOA] Proceedings of the 11th international Congress on Computational and Applied Mathematics, Leuven, Belgium, July 26-30, 2004.

#### **2.1.10 Mededelingen op andere congressen, integraal gepubliceerd in proceedings (AC)**

##### **2.1.11 Thesissen - doctoraat (TH)**

- [GOA] Statistical tools for non-life insurance: Essays on claims reserving and ratemaking for panels and fleets  
K. Antonio  
Doctoral dissertation K.U.Leuven, 2007.

##### **2.1.12 Interne rapporten, niet elders gepubliceerd (IR)**

- [GOA] A note on optimal lower bound approximations for risk measures of sums of lognormals  
S. Vanduffel, X. Chen, J. Dhaene, M. Goovaerts, R. Kaas, E. Valdez  
FETEW Research Report AFI\_0603, K.U.Leuven, 2006.

- [GOA] Basel II: Capital requirements for equity investment portfolios.  
F. Suarez , J. Dhaene, L. Henrard, S. Vanduffel,  
FETEW Research Report AFI\_0602, K.U.Leuven, 2006.
- [GOA] Some results on Denault's Capital Allocation Rule  
S. Vanduffel, J. Dhaene  
FETEW Research Report AFI\_0601, K.U.Leuven, 2006.
- [GOA] Asset Correlations:shifting tides  
A. Chernih, S. Vanduffel, L. Henrard  
FETEW Research Report AFI\_0618, K.U.Leuven, 2006.
- [GOA] On the suboptimality of path-dependent pay-offs in Lévy markets.  
S. Vanduffel, A. Chernih, W. Schoutens  
FETEW Research Report AFI\_0712, K.U.Leuven, 2007
- [GOA] Upper and Lower Bound Approximation for Transition Densities by Path Integral  
M. Goovaerts, Z. Shang, 2007  
To be published.
- [GOA] A New Iterative Algorithm for Calculating the Transition Densities for General Diffusion Process.  
M. Goovaerts, R. Laeven, Z. Shang, 2007  
To be published.
- [GOA] Closed-Form Approximations for Constant Continuous Annuities with Applications to Asian Options  
and Dollar Cost Averaging  
S. Vanduffel, J. Dhaene, L. Henrard, Z. Shang, E. Valdez, 2007  
To be published.
- [GOA] Hedging under the Heston Model with Jump-to-Default  
P. Carr, W. Schoutens, W  
Section of Statistics Technical Report 07-06, 2007.
- [GOA] Break on Through to the Single Side  
D.B. Madan, W. Schoutens  
Section of Statistics Technical Report 07-05, 2007.
- [GOA] Lévy Base Correlation  
J. Garcia, S. Goossens, V. Masol, W. Schoutens  
Section of Statistics Technical Report 07-04, 2007.
- [GOA] Multivariate Smiling  
P. Leoni, W. Schoutens  
Section of Statistics Technical Report 07-03, 2007.
- [GOA] Let's Jump Together - Pricing of Credit Derivatives: From Index Swaptions to CPPIs  
J. Garcia, S. Goossens, W. Schoutens  
Section of Statistics Technical Report 07-02, 2007.
- [GOA] The Little Heston Trap  
H. Albrecher, Ph. Mayer, W. Schoutens, J. Tistaert.  
K.U.Leuven. Section of Statistics TR 06-05, 2006.
- [GOA] Maximum Likelihood Estimation in Processes of Ornstein-Uhlenbeck type  
L. Valdivieso, W. Schoutens, F. Tuerlinckx  
UCS-Report 2006-03.

### **2.1.13 Andere publicaties (DI)**

## DOCTORANDI

David Schrager, Universiteit van Amsterdam, Departement Kwantitatieve Economie  
leden doctoraatscommissie: Marc Goovaerts  
verdediging: 09/02/2007

Sophie Ladoucette, K.U.Leuven, Departement Wiskunde  
promotoren: Jan Beirlant, Wim Schoutens  
leden doctoraatscommissie: Marc Goovaerts (voorzitter), Jan Dhaene  
verdediging: 14/03/2007

Katrien Antonio, K.U.Leuven, Departement Wiskunde  
promotor: Jan Beirlant  
leden doctoraatscommissie: Marc Goovaerts (voorzitter), Jan Dhaene, Wim Schoutens  
verdediging: 22/10/2007

## 2.2 ANDERE ACTIVITEITEN

### 2.2.1 *National and international cooperation*

In the framework of this GOA project a cooperation has been established between the GOA group and the Actuarial Section of the University of Amsterdam (Prof. R. Kaas, Prof. H. Wolthuis, Q. Tang, R. Laeven). Within Belgium a close cooperation exists between the GOA group and the University of Antwerp (A. De Schepper, M. Van Wouwe) and the University of Ghent (M. Vanmaele) as well as with the UCL (M. Denuit). All these cooperations have resulted in joint papers within the subject of the GOA. We are also cooperating with the university of Ljubljana (A. Ahcan), and the university of Lausanne (H. Gerber).

### 2.2.2 *Composition of the GOA working team*

#### Permanent staff

Marc Goovaerts (promoter)  
Jan Dhaene (co-promotor)

Jan Beirlant (toeleverancier)  
Wim Schoutens (toeleverancier)

#### Co-workers on the GOA budget

Xinliang Chen (assistant)  
Zhaoning Shang (assistant)  
Dion Heijnen (assistant)  
Robert Verlaak (assistant)

Koen Van Weert (assistant)  
Katrien Antonio (assistant)  
Mateusz Maj (assistant)  
Steven Vanduffel (postdoctoral researcher)

### 2.2.3 *International conferences, local seminars, workshops and invited lectures*

"4th Actuarial and Financial Mathematics Day", Brussels, Royal Flemish Academy of Belgium for Science and the Arts, February 10, 2006.

- Jan Dhaene: Co-organizer (jointly organized by Universiteit Gent, Universiteit Antwerpen, Vrije Universiteit Brussel, K.U.Leuven).
- Wim Schoutens (organizing committee)
- Fernando Mierzejewski: Economic Capital Allocation under Liquidity Constraints

Netspar Feb. 16, 2006

- M. Goovaerts, R. Kaas, S. Vanduffel: "Comonotonic approximations for optimal portfolio selection"

Seminarie 21 feb. Leuven, 2006

- M. Goovaerts: "IFRS en prudentieel toezicht" op 'De impact van IFRS op de bank- en verzekeringssector: stand van zaken'

Mathematics and its Applications Seminar, University of Antwerp, Antwerp, March 16, 2006.

- Katrien Antonio: Hierarchical Modelling Of Multilevel Claim Count Statistics.



Department of Mathematics, University of Ljubljana, Slovenia, March 17, 2006.

- Jan Dhaene: Reserving, capital allocation and pricing Asian options: three applications of comonotonicity, invited talk.

CentER, business and economics research institute, Tilburg University, The Netherlands, April 12, 2006.

- Katrien Antonio: Actuarial statistics and mixed models: applications and opportunities, Econometrics and statistics seminar.

Financieel Forum Antwerpen, 19 april 2006

- M. Goovaerts: "Solvency II: Onvermoede kansen"

Department of Mathematical Statistics, University of the Free State, Bloemfontein, South-Africa, April, 2006.

- Jan Dhaene: Unit-linked Insurance, invited talk.
- Jan Dhaene: "Profit testing in life insurance", 9 hours course.

28th International Congress of Actuaries, AFIR, Paris, May 28 – June 2, 2006.

- Dhaene J., Laeven R., Vanduffel S., Darkiewicz G., Goovaerts M.J.: Can a coherent risk measure be too subadditive?

School of business, University of Wisconsin (Madison), June 7, 2006.

- Katrien Antonio: "Recent development in claims reserving", invited talk.

First Leuven statistical day at KU Leuven, Leuven, June 12, 2006.

- Katrien Antonio: "Using mixed models in actuarial statistics", invited talk.

21st European Conference on Operational Research, Reykjavik, Iceland, July 2-5, 2006

- Marc Goovaerts: Worst case risk measurement: old ideas and new insight

ICCAM 2006 - 12th International Congress on Computational and Applied Mathematics, Leuven, 10/07/2006-14/07/2006

- Marc Goovaerts: conference director

Quant Congress 2006. N.Y., U.S.A, 11/07/2006-12/07/2006.

- Wim Schoutens: Extended session: Multivariate variance gamma modelling

10th International Congress on Insurance: Mathematics & Economics, Leuven, Belgium, July 18-20, 2006.

- Jan Dhaene: chairman scientific committee
- Marc Goovaerts: chairman organising committee
- Marc Goovaerts: Transition Densities for Diffusion Processes
- Chen X., Deelstra G., Dhaene J., Vanmaele M.: Static super-replicating strategies for exotic options.
- Antonio K., Beirlant J.: Issues in claims reserving and credibility: a semiparametric approach with mixed models.
- Fernando Mierzejewski: Liquidity Preference as Rational Behaviour under Uncertainty

4th World Congress of the Bachelier Finance Society, Tokyo, Japan, August 17-20, 2006:

- Chen X., Deelstra G., Dhaene J., Vanmaele M. Static super-replicating strategies for exotic options

4th Conference in Actuarial Science & Finance in Samos, Karlovassi, Greece, September 14-17, 2006.

- Chen X., Deelstra G., Dhaene J., Vanmaele M. Static super-replicating strategies for exotic options.
- Jan Dhaene: member organizing committee
- Marc Goovaerts: Scientific committee
- Marc Goovaerts: On Transition Densities for General Diffusion Processes
- Antonio K., Beirlant J.: Actuarial statistics with GLMMs and GAMMs.

Conference: Credit Risk under Lévy Models, Edinburgh, U.K, 22/09/2006.

- Wim Schoutens: A Generic One-Factor Levy Model for Pricing Synthetic CDOs.
- Wim Schoutens: Organizer.

60th birthday conference in honor of Prof. Dilip B. Madan, Maryland, U.S.A, 29/09/2006-01/10/2006.

- Wim Schoutens: A Generic One-Factor Levy Model for Pricing Synthetic CDOs.

14th Annual Meeting of the Belgian Statistical Society, Houffalize, October 12-13, 2006.

- Antonio K., Frees E.W., Valdez E.: Dependence modeling for multilevel data on fleet policies.

Brit Training Workshop, Advanced Equity Model, Grayston, South Africa, 06/11/2006-08/11/2006.

- Wim Schoutens: Advanced Equity Model.

Volatility Trading 2006, London, U.K, 27/11/2006-29/11/2006.

- Wim Schoutens: The Heston Trap : Are you using the right formula to calibrate ?

Simulation in Industry and Services, EHSAL, Brussels, 08/12/2006.

- Wim Schoutens: The Heston Trap : Are you using the right formula to calibrate ?

Faculté des HEC, Université de Lausanne, Switzerland, December 2006 – January 2007

- Jan Dhaene: Risk measures (12 hours course).
- Marc Goovaerts: Credibility theory (12 hours course).

Statistics Seminar, Leuven, December 15, 2006.

- Katrien Antonio: Hierarchical Modelling Of Multilevel Claim Count Statistics.

“5th Actuarial and Financial Mathematics Day”, Brussels, Royal Flemish Academy of Belgium for Science and the Arts, February 9, 2007.

- Jan Dhaene: Co-organizer (jointly organized by Universiteit Gent, Universiteit Antwerpen, Vrije Universiteit Brussel, K.U.Leuven).
- Wim Schoutens (organizing committee)
- Steven Vanduffel (co-organiser)
- Fernando Mierzejewski: An Actuarial Approach to Short-Run Monetary Equilibrium

Third Brazilian Conference on Statistical Modelling in Insurance and Finance, Maresias (Brasil), March 25-30, 2007

- Steven Vanduffel: Conditional Expectations as a Valuable Risk Management Tool (invited talk, as substitute for Marc Goovaerts)

Department of Insurance and Actuarial Science, University of Pretoria, Johannesburg, South Africa, April 5 2007

- Jan Dhaene: Risk measures, stochastic orders and comonotonicity.
- Marc Goovaerts: Risk measurement with equivalent utility.

Workshop on Integrated Risk Modeling, Tilburg University, Tilburg, April 11-13, 2007

- Katrien Antonio: Hierarchical Modelling Of Multilevel Claim Statistics.
- Wim Schoutens: The Heston trap - are you using the right characteristic function for Heston?

Department of Mathematical Statistics, University of the Free State, Bloemfontein, South Africa, April 13 2007.

- Jan Dhaene: Risk measures, stochastic orders and comonotonicity.
- Marc Goovaerts: Risk measurement with equivalent utility.

Astin dag, Amsterdam, May 8, 2007.

- Steven Vanduffel: Diversification: Facts and Tales

Mathematics and its Applications Seminar, Department of Mathematics, Statistics and Actuarial Sciences, University of Antwerp, Belgium, May 11, 2007

- Jan Dhaene: Comonotonicity: some actuarial applications.

International Actuarial Meeting on ‘Risk Measurement and Solvency’, organized in collaboration with the Turkish Statistical Association, The Turkish Society of Statisticians, at the occasion of the 5th Statistical Congress of Turkey, Antalya, Turkey, May 20-24, 2007.

- Jan Dhaene: Chairman of the Scientific Committee and member of the Organizing Committee
- Marc Goovaerts: Risk measures, from historical perspective (invited lecture)
- Steven Vanduffel: member of organizing committee and scientific committee
- Jan Dhaene: Risk measurement, choice under risk and stochastic orders
- Xinliang Chen: member of organizing committee
- Chen X., Deelstra G., Dhaene J., Vanmaele M., Static super-replicating strategies for exotic options

Radon Workshop on Financial and Actuarial Mathematics for Young Researchers, Linz, May 30 - 31, 2007

- Wim Schoutens: Lévy Processes Jumping into Credit Risk

XXII EURO Conference in Operational Research — Prague, July 08-11, 2007.

- Fernando Mierzejewski: Short-Run Monetary Equilibrium for Random Income

11th International Congress on Insurance: Mathematics & Economics, Piraeus, Greece, July 10-12, 2007

- Jan Dhaene: member of scientific and organizing committees
- Chen X., Dhaene J., Goovaerts, M.J., Henrard, L., Vanduffel, S. Optimal asset-mix studies in case of stochastic cash-flows
- Maj, M., Valdez, E., Dhaene J., Vanduffel S., Bounds for sums of dependent log-elliptical random variables
- Vanduffel, S., Chernih, A. On the suboptimality of path dependent pay-offs in Lévy markets
- Antonio K., Frees E.W., Valdez E.: Hierarchical Modeling of Multilevel Claim Count Statistics.
- Goovaerts M., Shang Z., (2007). Upper and Lower Bound Approximation for Transition Densities by Path Integral

Quant Congress USA 2007, New York, July, 12-13, 2007

- Wim Schoutens: Lévy Processes jumping into credit risk

Pricing & Modelling of CDOs & Structured Credit Products. Risk Training, London, September, 3-4, 2007

- Wim Schoutens: course tutor

Pricing & Modelling of CDOs & Structured Credit Products. Risk Training, New York, September, 17-18, 2007

- Wim Schoutens: course tutor

The Mathematical Aspects of Economics: Risk, Reassurance and Equilibrium in Chorzów, Poland. September 2007.

- DHAENE J., MAJ M., VALDEZ E., VANDUFFEL S.: Bounds for Sums of Dependent Log-Elliptical Random Variables.

Seminar at the University of Ljubljana, October 29, 2007

- Steven Vanduffel: On the suboptimality of path-dependent pay-offs in Lévy markets..

Quantitative Techniques for Credit Derivatives, London Financial Studies Course, London, October, 29-30, 2007

- Wim Schoutens: lecturer

Equity Derivatives : Advanced Models, London Financial Studies Course, London, November, 5-7, 2007

- Wim Schoutens: lecturer

Seminar at the UCL, Louvain-la-Neuve, November 12, 2007.

- Steven Vanduffel: On the suboptimality of path-dependent pay-offs in Lévy markets
- Steven Vanduffel: Closed-form approximations for constant continuous annuities with applications to Asian options and dollar cost averaging the suboptimality of path-dependent pay-offs in Lévy markets.

## **2.2.4 Stays abroad**

Marc Goovaerts:

Faculté des HEC, Université de Lausanne, Professeur invité ; November 2006 – December 2006

Jan Dhaene:

Department of Mathematical Statistics, University of the Free State, Bloemfontein, South Africa; April 2006 (3 weeks)

Faculté des HEC, Université de Lausanne, Professeur invité ; October 2006 – February 2007 (8.5%)

Department of Mathematical Statistics, University of the Free State, Bloemfontein, South-Africa, April 2007 (1.5 weeks)

Wim Schoutens:

Universitat de Barcelona, Barcelona, Spain, 01-07-2007 – 31-08-2007

## **2.2.5 Visiting faculty**

Kobus N. Bekker

Department Mathematical Statistics  
University of the Free State, South Africa  
Oktober 2007

Maria de Lourdes C. Centeno

Technical University of Lisbon, Portugal  
November 2007

Oleksandr Kukush

National Taras Shevchenko University, Ukraine  
August 2006

Griselda Deelstra

Université Libre de Bruxelles, Belgium  
October 2007

## 2.3 ABSTRACTS

- (IT) Actuarial statistics with generalized linear mixed models  
K. Antonio, J. Beirlant  
Insurance: Mathematics and Economics 40(1), 58-76, 2007.

Abstract: Over the last decade the use of generalized linear models (GLMs) in actuarial statistics received a lot of attention, starting from the actuarial illustrations in the standard text by McCullagh & Nelder (1989). Traditional GLMs however model a sample of independent random variables. Since actuaries very often have repeated measurements or longitudinal data (i.e. repeated measurements over time) at their disposal, this article considers statistical techniques to model such data within the framework of GLMs. Use is made of generalized linear mixed models (GLMMs) which model a transformation of the mean as a linear function of both fixed and random effects. The likelihood and Bayesian approaches to GLMMs are explained. The models are illustrated by considering classical credibility models and more general regression models for non-life ratemaking in the context of GLMMs. Details on computation and implementation (in SAS and WinBugs) are provided.

- (IT) Issues in claims reserving and credibility: a semiparametric approach with mixed models.  
K. Antonio & J. Beirlant  
Journal of Risk and Insurance, accepted for publication.

Abstract: Verrall (1996) and England & Verrall (2001) first considered the use of smoothing methods in the context of claims reserving. They applied two smoothing procedures in a likelihood-based way, namely the locally weighted regression smoother ('loess') and the cubic smoothing spline smoother. Using the statistical methodology of semiparametric regression and its connection with mixed models (see e.g. Ruppert et al., 2003), this paper revisits smoothing models for loss reserving and credibility. Apart from the flexibility inherent to all semiparametric methods, advantages of the semiparametric approach developed here are threefold. Firstly, a Bayesian implementation of these smoothing models is relatively straightforward and allows simulation from the full predictive distribution of quantities of interest. Since the main interest of actuaries lies in prediction, this is a major advantage. Secondly, because the constructed models have an interpretation as (generalized) linear mixed models ((G)LMMs), standard statistical theory and software for (G)LMMs can be used. Thirdly, more complex data sets, dealing for example with quarterly development in a reserving context, heavy-tails, semicontinuous data, or extensive longitudinal data, can be modelled within this framework. Throughout this work, data examples illustrate these different aspects. Several comments are included regarding model specification, estimation and selection.

- (IHb) Risk classification in non-life insurance  
K. Antonio & J. Beirlant  
Encyclopedia of Quantitative Risk Assessment -- Insurance/Actuarial Risks Section, Wiley, accepted for publication.

Abstract: Within the actuarial profession a major challenge can be found in the construction of a fair tariff structure. We discuss both a priori and a posteriori rating systems in light of the statistical techniques that are involved. The article introduces basic concepts, illustrates them with real-life actuarial data and summarizes references to complementary literature. Examples of likelihood-based as well as Bayesian estimation are included.

- (IT) Optimal approximations for risk measures of sums of lognormals based on conditional expectations  
S. Vanduffel, X. Chen, J. Dhaene, M. Goovaerts, L. Henrard, R. Kaas  
Journal of Computational and Applied Mathematics, accepted for publication.

Abstract: In this paper we investigate approximations for the distribution function of a sum  $S$  of  $n$  independent lognormal random variables. These approximations are obtained by considering the conditional expectation  $E[S \mid \Lambda]$  of  $S$  with respect to an appropriate conditioning random variable  $\Lambda$ .

Various choices for  $\Lambda$  have been proposed in the literature. Kaas et al. (2000) choose  $\Lambda$  as a normal random variable corresponding to a first-order approximation of the original sum  $S$ . Vanduffel et al. (2005a) determine  $\Lambda$  as a normal random variable such that the variance of the resulting approximation  $E[S \mid \Lambda]$  is as close as possible to the variance of the original  $S$ . Both choices can be considered as 'global' in the sense that  $\Lambda$  is chosen such that the whole distribution of the approximation  $E[S \mid \Lambda]$  is 'close' to the corresponding distribution of the original sum  $S$ .

In an actuarial or a financial context one is often only interested in a particular tail of the distribution of  $S$ . Therefore in this paper we propose approximations  $E[S \mid \Lambda]$  which are only locally optimal, in the sense that the relevant tail of the distribution of  $E[S \mid \Lambda]$  is an accurate approximation for the corresponding tail of the distribution of  $S$ . Numerical illustrations reveal that local optimal choices for  $\Lambda$

$\delta$  can significantly improve the quality of the approximations in the relevant tail.

We also explore asymptotic properties of the approximations  $E[S \mid \Lambda \leq \delta]$  and investigate links with results from Asmussen & Royas-Nadayapa (2005).

- (AT) Beyond Correlations: The Use and Abuse of Copulas in Economic Capital Calculations  
Chernih, M. Maj, S. Vanduffel (2007)  
Belgian Actuarial Bulletin, accepted for publication.

Abstract: Copulas have become a buzzword in recent years in the academic community, and practitioners are paying more and more attention to the choice of a copula in risk management applications. This paper gives a non-technical and pedagogical introduction to the topic of copulas and explains their role for economic capital calculations.

Risk professionals may be tempted to dress up models by using sophisticated tools like for instance copulas. This is because these toys give them the possibility to give a scientific flavour and “sérieux” to their models, and as such may serve as “an umbrella” towards the different stakeholders involved.

We provide examples to show that models that involve complicated copulas are by no means better than simple but robust and transparent models and do not always add value. However, building a simple as possible, but not too simple, model requires significant actuarial training and expertise.

- (IT) Risk measures and comonotonicity: a review  
J. Dhaene, S. Vanduffel, Q. Tang, M.J. Goovaerts, R. Kaas, D. Vyncke  
Stochastic Models, vol. 22, 573-606, 2006.

Abstract: In this paper we examine and summarize properties of several well-known risk measures that can be used in the framework of setting solvency capital requirements for a risky business. Special attention is given to the class of (concave) distortion risk measures. We investigate the relationship between these risk measures and theories of choice under risk. Furthermore we consider the problem of how to evaluate risk measures for sums of non-independent random variables. Approximations for such sums, based on the concept of comonotonicity, are proposed. Several examples are provided to illustrate properties or to prove that certain properties do not hold. Although the paper contains several new results, it is written as an overview and pedagogical introduction to the subject of risk measurement. The paper is an extended version of Dhaene et al.

- (IT) The use of a stochastic LGD in a credit default economic capital framework  
J. Dhaene, S. Vanduffel, M.J. Goovaerts, R. Koch, O. Olieslagers, Romijn  
Journal of Actuarial Practice. Accepted for publication.

Abstract: Despite the success of advanced credit portfolio models, many financial institutions still continue using a variance-covariance approach to portfolio modelling. When setting up such a framework, the parameters must be quantified and a certain number of assumptions has to be made. Assessing the level of the parameters is beyond the scope of this paper since they should ultimately pertain to peculiar features of the actual dataset. The different assumptions however should at least be mutually consistent, and a model with an inconsistent set of parameters is clearly unacceptable. We found that the concept of a stochastic loss given default in conjunction with default correlations can give rise to an inconsistent set of axioms. We propose two consistent methodologies that do not add (too much) complexity to the initial approach. These two models are also extremal in the sense that the first alternative will provide a lower bound for the variance of the portfolio loss whilst the second (comonotonic) alternative will provide an upperbound.

- (IT) Can a coherent risk measure be too subadditive?  
J. Dhaene, R. Laeven, S. Vanduffel, G. Darkiewicz, M.J. Goovaerts  
Journal of Risk and Insurance, accepted for publication.

Abstract: We consider the problem of determining appropriate solvency capital requirements for an insurance company or a financial institution. We demonstrate that the subadditivity condition that is often imposed on solvency capital principles can lead to the undesirable situation where the shortfall risk increases by a merger. We propose to complement the subadditivity condition by a regulator’s condition. We find that for an explicitly specified confidence level, the Value-at-Risk satisfies the regulator’s condition and is the “most efficient” capital requirement in the sense that it minimizes some reasonable cost function. Within the class of concave distortion risk measures, of which the elements, in contrast to the Value-at-Risk, exhibit the subadditivity property, we find that, again for an explicitly specified confidence level, the Tail-Value-at-Risk is the optimal capital requirement satisfying the regulator’s condition.

- (IT) Some results on the CTE based capital allocation rule  
J. Dhaene, L. Henrard, Z. Landsman, A. Vandendorpe, S. Vanduffel

Insurance: Mathematics & Economics, to be published.

Abstract: Tasche (1999) introduces a capital allocation principle where the capital allocated to each risk unit can be expressed in terms of its contribution to the conditional tail expectation (CTE) of the aggregate risk. Panjer (2002) derives a closed-form expression for this allocation rule in the multivariate normal case. Landsman & Valdez (2003) generalise Panjer's result to the class of multivariate elliptical distributions. In this paper we provide an alternative and simpler proof for the CTE based allocation formula in the elliptical case. Furthermore, we derive accurate and easy computable closed-form approximations for this allocation formula for sums that involve normal and lognormal risks.

- (IT) On the parameterization of the CreditRisk+ model for estimating credit portfolio risk  
A. Vandendorpe, N. Ho, S. Vanduffel, P. Van Dooren  
Insurance: Mathematics and Economics, accepted for publication.

Abstract: The Credit Risk+ model is one of the industry standards for estimating the credit default risk for a portfolio of credit loans. The natural parameterization of this model requires the default probability to be apportioned using a number of (non-negative) factor loadings. However, in practice only default correlations are often available but not the factor loadings. In this paper we investigate how to deduce the factor loadings from a given set of default correlations. This is a novel approach and it requires the non-negative factorization of a positive semi-definite matrix which is by no means trivial. We also present a numerical optimization algorithm to achieve this.

- (IT) Risk measurement with equivalent utility principles  
M. Denuit, J. Dhaene, M. Goovaerts, R. Kaas, R. Laeven  
Statistics & Decisions, vol. 24(1), 1-25, 2006.

Abstract: Risk measures have been studied for several decades in the actuarial literature, where they appeared under the guise of premium calculation principles. Risk measures and properties that risk measures should satisfy have recently received considerable attention in the financial mathematics literature. Mathematically, a risk measure is a mapping from a class of random variables to the real line. Economically, a risk measure should capture the preferences of the decision-maker.

This paper complements the study initiated in Denuit, Dhaene & Van Wouwe (1999) and considers several theories for decision under uncertainty: the classical expected utility paradigm, Yaari's dual approach, maximin expected utility theory, Choquet expected utility theory and Quiggin's rank-dependent utility theory. Building on the actuarial equivalent utility pricing principle, broad classes of risk measures are generated, of which most classical risk measures appear to be particular cases. This approach shows that most risk measures studied recently in the financial mathematics literature disregard the utility concept (i.e., correspond to linear utilities), restricting their applicability. Some alternatives proposed in the literature are discussed.

- (IT) On the characterization of premium principles under pointwise comonotonicity  
J. Dhaene, A. Kukush, M. Pupashenko  
Theory of Stochastic Processes, vol. 12 (28), N3-4, 27-45, 2006.

Abstract: A premium principle is an economic decision rule used by the insurer in order to determine the amount of the net premium for each risk in his portfolio. In this paper we investigate the problem how to determine the premium principle to be used. In Goovaerts & Dhaene (1997), DTEW Research Report 9740, K.U.Leuven, we can see some desirable properties of a premium principle. We consider a premium principle for risks of any sign, and prove a representation of premium principle without some property which involves the distribution of a risk. Later we introduce this property as a corollary.

- (IT) Bounds for the price of a European-style Asian option in a binary tree model  
H. Reynaerts H., M. Vanmaele, J. Dhaene, G. Deelstra  
European Journal of Operational Research, vol. 168(2), 322-332, 2006.

Abstract: Inspired by the ideas of Rogers and Shi (1995), Chalasani, Jha & Varikooty (1998) derived accurate lower and upper bounds for the price of a European-style Asian option with continuous averaging over the full lifetime of the option, using a discrete-time binary tree model. In this paper, we consider arithmetic Asian options with discrete sampling and we generalize their method to the case of forward starting Asian options. In this case with daily time steps, the method of Chalasani et al. is still very accurate but the computation can take a very long time on a PC when the number of steps in the binomial tree is high. We derive analytical lower and upper bounds based on the approach of Kaas, Dhaene & Goovaerts (2000) for bounds for stop-loss premiums of sums of dependent random variables, and by conditioning on the value of the underlying at the exercise date. The comonotonic upper bound corresponds to an optimal superhedging strategy. By putting in less information than Chalasani et al. the bounds lose some accuracy but are still very good and they are easily computable and

moreover the computation on a PC is fast. We illustrate our results by different numerical experiments and compare with bounds for the Black & Scholes model (1973) found in another paper Vanmaele et al. (2002). We notice that the intervals of Chalasani et al. do not always lie within the Black & Scholes intervals. We have proved that our bounds converge to the corresponding bounds in the Black & Scholes model. Our numerical illustrations also show that the hedging error is small if the Asian option is in the money. If the option is out of the money, the price of the superhedging strategy is not as adequate, but still lower than the straightforward hedge of buying one European option with the same exercise price.

- (IT) Recursions for the individual model  
J. Dhaene, C. Ribas, R. Vernic  
Acta Mathematica Applicatae Sinica, English Series, vol. 22(4), 631-652, 2006.

Abstract: In the actuarial literature, several exact and approximative recursive methods have been proposed for calculating the distribution of a sum of mutually independent compound Bernoulli distributed random variables. In this paper, we give an overview of these methods. We compare their performance with the straightforward convolution technique by counting the number of dot operations involved in each method. It turns out that in many practical situations, the recursive methods outperform the convolution method.

- (IT) Comonotonic bounds on the survival probabilities in the Lee-Carter model for mortality projection  
M. Denuit, J. Dhaene  
Journal of Computational and Applied Mathematics, vol. 203, 169-176, 2007.

In the Lee-Carter framework, future survival probabilities are random variables with an intricate distribution function. In large homogeneous portfolios of life annuities, Value-at-Risk or Conditional Tail Expectation of the total yearly payout of the company are approximately equal to the corresponding quantities involving random survival probabilities. This paper aims to derive some bounds in the increasing convex (or stop-loss) sense on these random survival probabilities. These bounds are obtained with the help of comonotonic upper and lower bounds on sums of correlated random variables.

- (IT) Asymmetric skew Bessel processes and their applications to finance.  
M. Decamps, M. Goovaerts, W. Schoutens  
Journal of Computational and Applied Mathematics 186 (1), 130-147, 2006.

Abstract: In this paper, we extend the Harrison and Shepp's construction of the skew Brownian motion (1981) and we obtain a diffusion similar to the two-dimensional Bessel process with speed and scale densities discontinuous at one point. Natural generalizations to multi-dimensional and fractional order Bessel processes are then discussed as well as invariance properties. We call this family of diffusions asymmetric skew Bessel processes in opposition to skew Bessel processes as defined in Barlow, Pitman and Yor (1989). We present factorizations involving (asymmetric skew) Bessel processes with random time. Finally, applications to the valuation of perpetuities and Asian options are proposed.

- (AT) Comonotonicity  
J. Dhaene, S. Vanduffel, M. Goovaerts  
Tijdschrift voor Economie en Management, vol. LII, 265-278, 2007.

Abstract: In an actuarial or financial context one often encounters the calculation of risk measures of random variables of the type. In many applications, the individual risks  $X_i$  are not mutually independent, for example because their outcomes are all influenced by the same economic or physical environment. Comonotonicity, which is an extremal form of positive dependence, can be used to determine easy to compute and accurate upper and lower bounds for the distribution of  $S$ , and hence, also for risk measures related to  $S$ .

- (IC) Static super-replicating strategies for exotic options  
X. Chen, G. Deelstra, J. Dhaene, M. Vanmaele  
4th Conference in Actuarial Science & Finance in Samos, Karlovassi, Greece, September 14-17, 2006.

Abstract: In this paper, we investigate static super-replicating strategies for European-type call options written on a weighted sum of asset prices. This class of exotic options includes Asian options and basket options among others. We assume that there exists a market where the plain vanilla options on the different assets are traded and hence their prices can be observed in the market. Both the infinite market case (where prices of the plain vanilla options are available for all strikes) and the finite market case (where only a finite number of plain vanilla option prices are observed) are considered.

We show how to construct a portfolio consisting of the plain vanilla options on the different assets, whose pay-off super-replicates the pay-off of the exotic option. As a consequence, the price of the super-replicating portfolio is

an upper bound for the price of the exotic option. The super-hedging strategy is model-free in the sense that it is expressed in terms of the observed option prices on the individual assets, which can be e.g. dividend paying stocks with no explicit dividend process known. This paper is a generalization of the work of Simon et al. (2000) who considered this problem for Asian options in the infinite market case. Laurence and Wang (2004) and Hobson et al. (2005) considered this problem for basket options, in the infinite as well as in the finite market case. As opposed to Hobson et al. (2005) who use Lagrange optimization techniques, the proofs in this paper are based on the theory of integral stochastic orders and on the theory of comonotonic risks.

- (IR) Asset Correlations: shifting tides  
A. Chernih, S. Vanduffel, L. Henrard  
FETEW Research Report AFI\_0618, K.U.Leuven, 2006.

Abstract: The Basel II Accord outlines a general framework for determining regulatory capital requirements for credit risk portfolios. Different obligors usually operate in dependent socio-economic environments and these structural correlations are the main reason why regulatory capital is needed. Therefore, it is not surprising that an important component of the regulatory regime for capital is the asset correlation between obligors. Basel II has set a range for corporate asset correlations from 8 to 24%, the exact value depending on several individual firm characteristics. We use monthly asset value data to calculate asset correlations and compare these with Basel II as well as results from other papers. Our results are in line with literature but a clear difference is found between the majority of these results and the results from Basel II and some major software providers. We discuss these differences and offer some explanations as an attempt to reconcile the differences: we argue that assuming independent loss given defaults can and should affect the asset correlations used. The impact of horizon is considered as well.

- (IR) On the suboptimality of path-dependent pay-offs in Lévy markets.  
S. Vanduffel, A. Chernih, W. Schoutens  
FETEW Research Report AFI\_0712, K.U.Leuven, 2007

Abstract: Cox & Leland (2000) use techniques from the field of stochastic control theory to show that in the particular case of a Brownian motion for the asset returns all risk averse decision makers with a fixed investment horizon prefer path-independent pay-offs over path-dependent ones. We will provide a novel and simple proof for the Cox & Leland result and we will extend it to general, not necessarily complete, Lévy markets. It is also shown that in these markets optimal path-independent pay-offs have final values increasing with the underlying asset value. Our results imply that path-dependent investment pay-offs, the use of which is widespread in financial markets, do not appear to offer good value for risk averse decision makers with a fixed investment horizon.

- (IT) Actuarial risk measures for financial derivative pricing  
M. Goovaerts, R. Laeven  
Insurance: Mathematics and Economics, accepted for publication (2007)

Abstract: We present an axiomatic characterization of price measures that are superadditive and comonotonic additive for normally distributed random variables. The price representation derived, involves a probability measure transform that is closely related to the Esscher transform, and we call it the Esscher-Girsanov transform. In a financial market in which the primary asset price is represented by a stochastic differential equation with respect to Brownian motion, the price mechanism based on the Esscher-Girsanov transform can generate approximate-arbitrage-free financial derivative prices.

- (IT) On Risk Measures and Decisions in Insurance and Finance  
M. Goovaerts, R. Kaas, R. Laeven  
Insurance: Mathematics and Economics, to be published (2007)

Abstract: In this paper we argue that there exists a distinction between risk measures and decision principles. Though both can be regarded as functionals assigning a real number to a random variable, we think that there is a hierarchy between the two concepts. Risk measures operate on the first "level", quantifying the risk in the situation under consideration, while decision principles operate on the second "level", being derived from the risk measure. We will briefly illustrate this distinction with several examples of economic situations encountered in the insurance and financial industry. Special attention is paid to the role of axiomatic characterizations in determining risk measures and decision principles. Some new axiomatic characterizations of families of risk measures and decision principles are also presented.

- (IR) Upper and Lower Bound Approximation for Transition Densities by Path Integral  
M. Goovaerts, Z. Shang, 2007  
To be published.



Abstract: Path integral formalism has been known as an alternative approach to financial modelling and derivative pricing. It is a powerful tool borrowed from physics which connects quantum theory and arbitrage free pricing in finance. The explicit expressions for transition densities could be derived for several classical models. We applied the concepts of comonotonicity and convex combination to derive the closed-form approximations when close-form expressions doesn't exist or too cumbersome to work out. Two upper and lower bounds are proposed which present closed-form approximations for the transition densities, especially for the path-dependent derivatives.

- (IR) Hedging under the Heston Model with Jump-to-Default  
P. Carr, W. Schoutens, W  
Section of Statistics Technical Report 07-06, 2007.

Abstract: In this paper we will explain how to perfectly hedge under Heston's stochastic volatility model with jump to default, which is in itself a generalization of the Merton jump-to-default model and a special case of the Heston model with jumps. The hedging instruments we use to build the hedge will be as usual the stock and the bond, but also the Variance Swap (VS) and a Credit Default Swap (CDS). These instruments are very natural choices in this setting as the VS hedges against changes in the instantaneous variance rate, while the CDS protects against the occurrence of the default event.

First, we explain how to perfectly hedge a power payoff under the Heston model with jump to default. These theoretical payoffs play an important role later on in the hedging of payoffs which are more liquid in practice such as vanilla options. After showing how to hedge the power payoffs, we show how to hedge newly introduced Gamma payoffs and Dirac payoffs, before turning to the hedge for the vanillas. The approach is inspired by the Post-Widder formula for real inversion of Laplace Transforms. Finally, we will also show how power payoffs can readily be used to approximate any payoff only depending on the value of the underlier at maturity. Here, the theory of orthogonal polynomials comes into play and the technique is illustrated by replicating the payoff of a vanilla call option.

- (IR) Break on Through to the Single Side  
D.B. Madan, W. Schoutens  
Section of Statistics Technical Report 07-05, 2007.

Abstract: We employ a Lévy process subject to only negative jumps to describe the motion of asset values. This specification permits fast computation of first passage probabilities. As a result we are able to calibrate all CDS curves for the 125 iTraxx underliers weekly and develop a time series for the implied parameter values. A variety of models are investigated for the process: gamma, inverse Gaussian and the one sided CGMY, here referred to as CMY.

- (IR) Lévy Base Correlation  
J. Garcia, S. Goossens, V. Masol, W. Schoutens  
Section of Statistics Technical Report 07-04, 2007.

Abstract: In this paper we investigate one factor models that extend the classical Gaussian copula model for pricing CDOs. The proposed models are very tractable and perform significantly better than the classical Gaussian copula model. Moreover, we introduce the concept of Lévy base correlation. The obtained Lévy base correlation curve is much flatter than the corresponding Gaussian one. This indicates that the models do fit the observed data much better. Additionally, flat base correlation curves are also much more reliable for pricing of bespoke tranches.

- (IR) Multivariate Smiling  
P. Leoni, W. Schoutens  
Section of Statistics Technical Report 07-03, 2007.

Abstract: The paper presents an application of the Variance Gamma distribution to price multivariate derivatives. The paper focuses on the practical implementation of the model in a multivariate setting. Several calibration procedures are discussed and applied to examples. In particular, we focus on the pricing differences for several exotic structures between the MultiVariate Variance-Gamma Model and the MultiVariate Black-Scholes Flat Volatility Model.

- (IR) Let's Jump Together - Pricing of Credit Derivatives: From Index Swaptions to CPPIs  
J. Garcia, S. Goossens, W. Schoutens  
Section of Statistics Technical Report 07-02, 2007.

Abstract: This paper describes a dynamic multivariate jump driven model in a credit setting. We set up a dynamic Lévy model, more precisely a Multivariate Variance Gamma (VG) model, for a series of correlated spreads. The

parameters of the model come from a two step calibration procedure. First, a joint calibration on swaptions on the spreads is performed and second, a correlation matching procedure is applied. For the first calibration step, we make use of equity-like pricing formulas for payer and receiver swaptions, based on the characteristic function and the Fast Fourier Transform (FFT) method. In the second calibration step, we fix the correlation in the model to match the prescribed (in casu historically observed) correlation. This can be done fast since a closed form expression is readily available. The resulting jump driven dynamic model generates correlated spreads very fast. This model can be used to price a whole range of exotic structures. We illustrate this by pricing the currently popular credit Constant Proportion Portfolio Insurance (CPPI) structures. Because of the built in jump dynamics a better assessment of gap risk is possible.

- (IR) The Little Heston Trap  
H. Albrecher, Ph. Mayer, W. Schoutens, J. Tistaert.  
K.U.Leuven. Section of Statistics TR 06-05, 2006.

Abstract: The role of characteristic functions in finance has been strongly amplified by the development of the general option pricing formula by Carr and Madan. As these functions are defined and operating in the complex plane, they potentially encompass a few well known numerical issues due to "branching". A number of elegant publications have emerged tackling these effects specifically for the Heston model. For the latter however we have two specifications for the characteristic function as they are the solutions to a Riccati equation. In this article we put the i's and cross the t's by formally pointing out the properties of and relations between both versions. For the first specification we show that for nearly any parameter choice, instabilities will occur for large enough maturities. We subsequently establish - under an additional parameter restriction - the existence of a "threshold" maturity from which the complex operations become a spoil-sport. For the second specification of the characteristic function it is proved that stability is guaranteed under the full dimensional and unrestricted parameter space. We blend the theoretical results with a few examples.

- (IR) Maximum Likelihood Estimation in Processes of Ornstein-Uhlenbeck type  
L. Valdivieso, W. Schoutens, F. Tuerlinckx  
UCS-Report 2006-03.

Abstract: In this article we propose a maximum likelihood methodology to estimate the parameters of a one-dimensional stationary process of Ornstein-Uhlenbeck type that is constructed via a self-decomposable distribution  $D$ . Our approach is based on the inversion of the characteristic function and the use of the classical or fractional discrete fast Fourier transform. The results are illustrated throughout an extensive simulation study. This includes the cases where  $D$  belongs to the gamma, tempered stable and normal inverse Gaussian family of distributions.

- (IT) Pricing credit default swaps under Lévy models  
J. Cariboni, W. Schoutens  
Journal of Computational Finance 10(4), 1-21, 2007.

Abstract: Most structural models for credit pricing assume Geometric Brownian motion to describe the firm asset value. However, the underlying lognormal distribution does not match empirical distributions, typically skewed and leptokurtic. Moreover, defaults are usually driven by shocks, which are not captured by the continuous paths of Brownian motion. We assume the asset price process is driven by a pure-jump Lévy process and default is triggered by the crossing of a preset barrier. Our model incorporates asymmetry, fat-tail behaviour, jumps and instantaneous defaults. Under this model we price Credit Default Swaps, detailing the calculations for the Variance Gamma process.

- (IT) The Little Heston Trap  
H. Albrecher, Ph. Mayer, W. Schoutens, J. Tistaert  
Wilmott Magazine, January Issue, 83-92, 2007.

Abstract: The role of characteristic functions in finance has been strongly amplified by the development of the general option pricing formula by Carr and Madan. As these functions are defined and operating in the complex plane, they potentially encompass a few well known numerical issues due to "branching". A number of elegant publications have emerged tackling these effects specifically for the Heston model. For the latter however we have two specifications for the characteristic function as they are the solutions to a Riccati equation. In this article we put the i's and cross the t's by formally pointing out the properties of and relations between both versions. For the first specification we show that for nearly any parameter choice, instabilities will occur for large enough maturities. We subsequently establish - under an additional parameter restriction - the existence of a "threshold" maturity from which the complex operations become a spoil-sport. For the second specification of the characteristic function it is proved that stability is guaranteed under the full dimensional and unrestricted parameter space. We blend the theoretical results with a few examples.

- (IT) A generic one-factor Lévy model for pricing synthetic CDOs  
H. Albrecher, S. Ladoucette, W. Schoutens  
Advances in Mathematical Finance, R.J. Elliott et al. (eds.), Birkhaeuser, 2007.

Abstract: The one-factor Gaussian model is well-known not to fit simultaneously the prices of the different tranches of a collateralized debt obligation (CDO), leading to the implied correlation smile. Recently, other one-factor models based on different distributions have been proposed. Moosbrucker [12] used a one-factor Variance Gamma model, Kalemánova et al. [7] and Guégan and Houdain [6] worked with a NIG factor model and Baxter [3] introduced the BVG model. These models bring more flexibility into the dependence structure and allow tail dependence. We unify these approaches, describe a generic one-factor Lévy model and work out the large homogeneous portfolio (LHP) approximation. Then, we discuss several examples and calibrate a battery of models to market data.

- (IT) Self exciting threshold interest rates models. Asymmetric skew Bessel processes and their applications to finance.  
M. Decamps, M. Goovaerts, W. Schoutens  
International Journal of Theoretical and Applied Finance, 9 (7), 1093-1122.

Abstract: In this paper, we study a new class of tractable diffusions suitable for model's primitives of interest rates. We consider scalar diffusions with scale  $s(x)$  and speed  $m(x)$  densities discontinuous at the level  $x^*$ . We call that family of processes Self Exciting Threshold (SET) diffusions. Following Gorovoi and Linetsky (2004), we obtain semi-analytical expressions for the transition density of SET (killed) diffusions. We propose several applications to interest rates modeling. We show that SET short rate processes do not generate arbitrage possibilities and we adapt the HJM procedure to forward rates with discontinuous scale density. We also extend the CEV and the shifted lognormal Libor market models. Finally, the models are calibrated to the U.S. market. SET diffusions can also be used to model stock price, stochastic volatility, credit spread, etc.

- (IT) A Multivariate Jump-Driven Financial Asset Model  
E. Luciano, W. Schoutens  
Quantitative Finance 6 (5), 385-402, 2006.

Abstract: We discuss a Lévy multivariate model for financial assets which incorporates jumps, skewness, kurtosis and stochastic volatility. We use it to describe the behavior of a series of stocks or indexes, and to study a multi-firm, value-based default model. Starting from an independent Brownian world, we introduce jumps and other deviations from normality, including non-Gaussian dependence. We use a stochastic time-change technique and provide the details for a Gamma change. The main feature of the model is the fact that - opposite to other, non jointly Gaussian settings - its risk neutral dependence can be calibrated from univariate derivative prices, providing a surprisingly good fit.

- (IT) Optimal investment in a Lévy market  
J.M. Corcuera, J. Guerra, D. Nualart, W. Schoutens  
Applied Mathematics and Optimization, 2006.

Abstract: The stock price process is modelled by a geometric Lévy process (taking into account jumps). Except for the geometric Brownian model and the geometric Poissonian model, the resulting models are incomplete and there are many equivalent martingale measures. However the model can be completed by the so called power-jump assets. By doing this we allow investment in these new assets and we can try to maximize the utility of these portfolios. As particular cases we obtain the optimal portfolios based in stocks and bonds, showing that the new assets are superfluous for certain martingale measures that depend on the utility function we use.

- (IT) The Importance of Jumps in Pricing European Options  
F. Campolongo, J. Cariboni, W. Schoutens  
Reliab. Eng. Syst. Saf. 91(10-11), 1148-1154, 2006.

Abstract: The screening method proposed by Morris [1] and recently improved by Campolongo et al. has been employed to estimate the importance of the inclusion of jumps in a model for pricing European options. Results confirm that, among the sources of uncontrollable uncertainty, jumps play a major role and therefore need to be better investigated in order to improve the accuracy of the model predictions.

- (IT) Exotic options under Lévy models: An overview  
W. Schoutens  
Journal of Computational and Applied Mathematic, 189, 526-538, 2006.

Abstract: In this paper we overview the pricing of several so-called exotic options in the nowadays quite popular

exponential Lévy models.

- (IT) Iterates of the infinitesimal generator and space-time harmonic polynomials of a Markov process  
P.M. Barrieu, W. Schoutens  
Journal of Computational and Applied Mathematics, 186 (1), 300-323, 2006.

Abstract: We relate iterates of the infinitesimal generator of a Markov process to space-time harmonic functions. First, we develop the theory for a general Markov process and create a family of space-time martingales. Next, we investigate the special class of subordinators. Combinatorics results on space-time harmonic polynomials and generalized Stirling numbers are developed and interpreted from a probabilistic point of view. Finally, we introduce the notion of pairs of subordinators in duality, investigate the implications on the associated martingales and consider some explicit examples.

- (IT) Worst case risk measurement: back to the future?  
R. Laeven, M. Goovaerts, R. Kaas  
To be published (2007)

Abstract: This paper studies the problem of finding best-possible upper bounds on risk measures under incomplete probabilistic information. Both the case of univariate risk and the case of multivariate risk are considered. Furthermore, we aim to identify the probability distributions that give rise to the worst case scenarios. The problem of worst case risk measurement has been studied extensively by Etienne De Vijlder and his co-authors. We review and extend some of their work. To our regret, Etienne passed away in the beginning of the year 2004. As a sign of gratitude for his large contribution to Actuarial Science, we dedicate this work to him.

- (AT) Decision Principles derived from Risk Measures  
M. Goovaerts, R. Kaas, R. Laeven  
Hermis Vol. 8, pp. 109-124, 2007

Abstract: In this paper, we argue that there exists a distinction between risk measures and decision principles. Though both can be regarded as functionals assigning a real number to a random variable, we think that there is a hierarchy between the two concepts. Risk measures operate on the first "level", quantifying the risk in the situation under consideration, while decision principles operate on the second "level", being derived from the risk measure. We will briefly illustrate this distinction with several examples of economic situations encountered in the insurance and financial industry.

- (IHb) Premium calculations and insurance pricing  
R. Laeven, M. Goovaerts  
Wiley Encyclopedia of Quantitative Risk Assessment, to be published.

Abstract: This survey of premium calculation and insurance pricing explains classical theories and their recent generalizations, summarizes main issues and results, and describes current developments in the area.