

Ruodu Wang, Ph.D.

Curriculum Vitae

Associate Professor
Department of Statistics and Actuarial Science
University of Waterloo
Mathematics 3, 200 University Avenue West
Waterloo, Ontario, Canada N2L 3G1

Office: M3 Room 3122
Phone: (519) 888-4567 ext. 31569
Email: wang@uwaterloo.ca
Website: <http://sas.uwaterloo.ca/~wang>

Employment

Associate Professor of Actuarial Science, University of Waterloo (early tenure)	2017.07 - present
Assistant Professor of Actuarial Science, University of Waterloo	2012.08 - 2017.06

Education

Ph.D. Mathematics, Georgia Institute of Technology. Advisor: Liang Peng	2012.05
M.S. Financial Mathematics, Peking University. Advisor: Jingping Yang	2009.06
B.S. Mathematics, Peking University	2006.06

Research Areas

Probability · Statistics · Quantitative Risk Management
Actuarial Science · Financial Engineering · Operations Research

Editorial Duties

Co-Editor, <i>ASTIN Bulletin - The Journal of the International Actuarial Association</i>	from 2018.01
Co-Editor, <i>European Actuarial Journal</i>	2016.08 - present
Associate Editor, <i>Acta Mathematicae Applicatae Sinica (English Series)</i>	2016.07 - present
Member of the Editorial Advisory Board, <i>Dependence Modeling</i>	2014.12 - present

Grants

NSERC Discovery Grant (RGPIN-435844-2013, PI)	2013 - 2018
International Research Partnership Grant April 2016, University of Waterloo (Co-PI)	2016 - 2018

Visiting Positions (> 1 month)

Risklab, Department of Mathematics, ETH Zurich	2017.04 - 2017.07
Institute of Applied Mathematics, Chinese Academy of Sciences	2016.07 - 2016.08
School of Mathematical Sciences, Peking University	2016.03 - 2016.04
Risklab, Department of Mathematics, ETH Zurich	2015.08 - 2015.12
China Institute for Actuarial Science, Central University of Finance and Economics	2014.07 - 2014.08
Risklab, Department of Mathematics, ETH Zurich	2013.09 - 2013.11
School of Mathematical Sciences, Peking University	2013.06 - 2013.07
School of Mathematical Sciences, Peking University	2012.06 - 2012.07

Publications and Manuscripts

Refereed Journal Articles

Forthcoming

- [41] Jakobsons, E. and Wang, R. (2017+). Negative dependence in matrix arrangement problems. *Annals of Operations Research*, forthcoming.
- [40] Embrechts, P., Liu, H. and Wang, R. (2017+). Quantile-based risk sharing. *Operations Research*, forthcoming.
- [39] Li, L., Shao, H., Wang, R. and Yang, J. (2017+). Worst-case Range Value-at-Risk with partial information. *SIAM Journal on Financial Mathematics*, forthcoming.
- [38] Cai, J., Liu, H. and Wang, R. (2017+). Asymptotic equivalence of risk measures under dependence uncertainty. *Mathematical Finance*, forthcoming.

2017

- [37] Cai, J., Liu, H. and Wang, R. (2017). Pareto-optimal reinsurance arrangements under general model settings. *Insurance: Mathematics and Economics*, **77**, 24–37.
- [36] Furman, E., Wang, R. and Zitikis, R. (2017). Gini-type measures of risk and variability: Gini shortfall, capital allocations, and heavy-tailed risks. *Journal of Banking and Finance*, **83**, 70–84.
- [35] Bernard, C., Rüschendorf, L., Vanduffel, S. and Wang, R. (2017). Risk bounds for factor models. *Finance and Stochastics*, **21**(3), 631–659.
- [34] Liu, H. and Wang, R. (2017). Collective risk models with dependence uncertainty. *ASTIN Bulletin*, **47**(2), 361–389.

2016

- [33] Wang, B. and Wang, R. (2016). Joint mixability. *Mathematics of Operations Research*, **41**(3), 808–826.

- [32] Embrechts, P., Hofert, M. and Wang, R. (2016). Bernoulli and tail-dependence compatibility. *Annals of Applied Probability*, **26**(3), 1636–1658.
- [31] Bignozzi, V., Mao, T., Wang, B. and Wang, R. (2016). Diversification limit of quantiles under dependence uncertainty. *Extremes*, **19**(2), 143–170.
- [30] Wang, R. (2016). Regulatory arbitrage of risk measures. *Quantitative Finance*, **16**(3), 337–347.
- [29] Han, X. and Wang, R. (2016). Computation of credit portfolio loss distribution by a cross entropy method. *Journal of Applied Mathematics and Computing*, **52**(1), 287–304.
- [28] Jakobsons, E., Han, X. and Wang, R. (2016). General convex order on risk aggregation. *Scandinavian Actuarial Journal*, **2016**(8), 713–740.

2015

- [27] Puccetti, G. and Wang, R. (2015). Extremal dependence concepts. *Statistical Science*, **30**(4), 485–517.
- [26] Embrechts, P. and Wang, R. (2015). Seven proofs for the subadditivity of Expected Shortfall. *Dependence Modeling*, **3**, 126–140.
- [25] Embrechts, P., Wang, B. and Wang, R. (2015). Aggregation-robustness and model uncertainty of regulatory risk measures. *Finance and Stochastics*, **19**(4), 763–790.
- [24] Wang, R. (2015). Current open questions in complete mixability. *Probability Surveys*, **12**, 13–32.
- [23] Wang, R., Bignozzi, V. and Tsanakas, A. (2015). How superadditive can a risk measure be? *SIAM Journal on Financial Mathematics*, **6**(1), 776–803.
- [22] Mao, T. and Wang, R. (2015). On aggregation sets and lower-convex sets. *Journal of Multivariate Analysis*, **138**, 170–181.
- [21] Wang, R. and Ziegel, J. (2015). Elicitable distortion risk measures: A concise proof. *Statistics and Probability Letters*, **100**, 172–175.
- [20] Wang, B. and Wang, R. (2015). Extreme negative dependence and risk aggregation. *Journal of Multivariate Analysis*, **136**, 12–25.
- [19] Yang, J., Chen, Z., Wang, F. and Wang, R. (2015). Composite Bernstein copulas. *ASTIN Bulletin*, **45**(2), 445–475.
- [18] Wang, R., Peng, L. and Yang, J. (2015). CreditRisk⁺ model with dependent risk factors. *North American Actuarial Journal*, **19**(1), 24–40.
- [17] Puccetti, G. and Wang, R. (2015). Detecting complete and joint mixability. *Journal of Computational and Applied Mathematics*, **280**, 174–187.

2014

- [16] Peng, L. and Wang, R. (2014). Interval estimation for bivariate t-copulas via Kendall's tau. *Variance*, **8**(1), 43–54.
- [15] Wang, R. (2014). Sum of arbitrarily dependent random variables. *Electronic Journal of Probability*, **19**(84), 1–18.

- [14] Embrechts, P., Puccetti, G., Rüschendorf, L., Wang, R. and Beleraj, A. (2014). An academic response to Basel 3.5. *Risks*, **2**(1), 25–48.
- [13] Peng, L., Qi, Y. and Wang, R. (2014). Empirical likelihood test for high-dimensional linear models. *Statistics and Probability Letters*, **86**, 85–90.
- [12] Wang, R. (2014). Asymptotic bounds for the distribution of the sum of dependent random variables. *Journal of Applied Probability*, **51**(3), 780–798.
- [11] Bernard, C., Jiang, X. and Wang, R. (2014). Risk aggregation with dependence uncertainty. *Insurance: Mathematics and Economics*, **54**, 93–108.

2013

- [10] Puccetti, G., Wang, B. and Wang, R. (2013). Complete mixability and asymptotic equivalence of worst-possible VaR and ES estimates. *Insurance: Mathematics and Economics*, **53**(3), 821–828.
- [9] Zhang, R., Peng, L. and Wang, R. (2013). Tests for covariance matrix with fixed or divergent dimension. *Annals of Statistics*, **41**(4), 2075–2096.
- [8] Wang, R., Peng, L. and Qi, Y. (2013). Jackknife empirical likelihood test for equality of two high dimensional means. *Statistica Sinica*, **23**(2), 667–690.
- [7] Wang, R., Peng, L. and Yang, J. (2013). Bounds for the sum of dependent risks and worst Value-at-Risk with monotone marginal densities. *Finance and Stochastics*, **17**(2), 395–417.
- [6] Wang, R., Peng, L. and Yang, J. (2013). Jackknife empirical likelihood for parametric copulas. *Scandinavian Actuarial Journal*, **2013**(5), 325–339.

2009 - 2012

- [5] Peng, L., Qi, Y., Wang, R. and Yang, J. (2012). Jackknife empirical likelihood method for some risk measures and related quantities. *Insurance: Mathematics and Economics*, **51**(1), 142–150.
- [4] Puccetti, G., Wang, B. and Wang, R. (2012). Advances in complete mixability. *Journal of Applied Probability*, **49**(2), 430–440.
- [3] Wang, R. and Peng, L. (2011). Jackknife empirical likelihood intervals for Spearman’s rho. *North American Actuarial Journal*, **15**(4), 475–486.
- [2] Wang, B. and Wang, R. (2011). The complete mixability and convex minimization problems for monotone marginal densities. *Journal of Multivariate Analysis*, **102**(10), 1344–1360.
- [1] Yang, J., Qi, Y. and Wang, R. (2009). A class of multivariate copulas with bivariate Fréchet marginal copulas. *Insurance: Mathematics and Economics*, **45**(1), 139–147.

Other Publications

- [1] Major, J., Wang, R. and Woolstenhulme, M. (2015). The most dangerous model: A natural benchmark for assessing model risk. *Society of Actuaries Monograph: Enterprise Risk Management Symposium, 2015*.

Submitted Manuscripts

- [10] Embrechts, P., Liu, H., Mao, T. and Wang, R. (2017). Quantile-based risk sharing with heterogeneous beliefs.
SSRN: <http://ssrn.com/abstract=3079998>.
- [9] Wang, R., Xu, Z. Q. and Zhou, X. Y. (2017). Dual utilities under dependence uncertainty.
SSRN: <http://ssrn.com/abstract=3078374>.
- [8] Asimit, V., Peng, L., Wang, R. and Yu, A. (2017). An efficient approach to quantile capital allocation and sensitivity analysis.
- [7] Shen, J., Shen, Y., Wang, B. and Wang, R. (2017). Distributional compatibility for change of measures.
arXiv: <https://arxiv.org/abs/1706.01168>.
- [6] Wang, R., Wei, Y. and Willmot, G. (2017). Characterization, robustness and aggregation of signed Choquet integrals.
SSRN: <http://ssrn.com/abstract=2956962>.
- [5] Puccetti, G., Rigo, P., Wang, B. and Wang, R. (2017). Centers of probability measures without the mean.
arXiv: <https://arxiv.org/abs/1704.02660>.
- [4] Mao, T. and Wang, R. (2017). A model-free continuum of degrees of risk aversion.
SSRN: <http://ssrn.com/abstract=2907499>.
- [3] Liu, F. and Wang, R. (2016). A theory for measures of tail risk.
SSRN: <http://ssrn.com/abstract=2841909>.
- [2] Shen, J., Shen, Y. and Wang, R. (2016). Random locations of periodic stochastic processes.
arXiv: <http://arxiv.org/abs/1603.01527>.
- [1] Mao, T. and Wang, R. (2016). Risk aversion in regulatory capital principles.
SSRN: <http://ssrn.com/abstract=2658669>.

Dissertation

- [1] Wang, R. (2012). Some questions in high-dimensional data analysis and risk management. *Ph.D. Thesis*. Georgia Institute of Technology, USA.

Books

- [1] Wang, R. (2011). *Sanguosha: The Royal Road*. (Non-academic, in Chinese.) Publishing House of Electronics Industry, Beijing. ISBN-9787121126833.

Academic Advising

Ph.D. students at the University of Waterloo

Yunran Wei (co-supervision with G. Willmot)	2015.09 - present
Jie Shen (co-supervision with Y. Shen)	2014.09 - present

Haiyan Liu (co-supervision with J. Cai)	2013.09 - 2017.04
Assistant Professor (tenure-track), Michigan State University	(2017)

Master's students (thesis-based) at the University of Waterloo

Xiao Jiang (co-supervision with C. Bernard)	2012.09 - 2013.12
Investment Analyst, Canada Pension Plan Investment Board	(2014)

Postdoctoral fellows at the University of Waterloo

Daniel Linders (co-supervision with F. Yang, short term)	2015.06 - 2015.08
Assistant Professor (tenure-track), University of Illinois Urbana-Champaign	(2017)
Tiantian Mao (co-supervision with J. Cai and D. Landriault)	2014.04 - 2015.03
Associate Professor (tenured), University of Science and Technology of China	(2017)

Teaching

University of Waterloo

ACTSC446/846 - Mathematics of Financial Markets	Winter 2013, Fall 2014
ACTSC625 - Casualty and Health Insurance Mathematics	Winters 2013, 2014, 2015, 2017
ACTSC631 - Financial Mathematics III	Spring 2015
ACTSC964 - Topics in Quantitative Risk Management	Winter 2017
ACTSC970 - Finance I	Fall 2016
ACTSC971 - Finance II	Winter 2015
ACTSC991 - Topics in Actuarial Science - Copulas and Dependence Modeling	Winter 2014
ACTSC991 - Topics in Actuarial Science - Risk Measurement	Spring 2015

Georgia Institute of Technology

MATH1522 - Linear Algebra for Calculus	Spring 2012
--	-------------

Invited Short Courses and Minicourses

Chinese Academy of Sciences

Minicourse - Risk Measurement under Model Uncertainty (4 hours)	Spring 2016
---	-------------

Peking University

Short Course - Theory and Practice of Risk Measurement (20 hours) Spring 2016

ETH Zurich

FIM Minicourse - Risk Aggregation and Fréchet Problems (10 hours) Fall 2015

University of Milan-Bicocca

Minicourse - Risk Aggregation and Fréchet Problems (10 hours) Fall 2015

Invited Presentations

[C]: Conference presentations; [S]: Seminars

2017

[S] Department of Mathematics, University of Connecticut, USA 2017.11
 [S] School of Mathematics and Statistics, Wuhan University, China 2017.11
 [S] Lab of Earth Surface Processes and Resource Ecology, Beijing Normal University, China 2017.11
 [S] School of Statistics, Qufu Normal University, China 2017.11
 [S] School of Management, University of Science and Technology of China, China 2017.10
 [S] Institute of Applied Mathematics, Chinese Academy of Sciences, China 2017.10
 [S] School of Mathematical Sciences, Peking University, China 2017.07
 [C] 8th Conference, Advanced Mathematical Methods in Finance, Amsterdam, Netherlands. 2017.06
 [S] Department for Mathematics, University of Salzburg, Austria. 2017.06
 [S] School of Economics and Statistics, University of Milano-Bicocca, Italy. 2017.05
 [C] 4th Workshop on Recent Developments in Dependence Modeling, Aegina, Greece. 2017.05
 [C] ETH Zurich RiskLab Mini-Workshop, Zurich, Switzerland. 2017.04
 [S] Department of Mathematics, Ryerson University, Canada. 2017.03
 [S] Actuarial School, Laval University, Canada. 2017.03

2016

[S] Department of Statistics, University of Michigan, USA 2016.11
 [S] Robinson College of Business, Georgia State University, USA 2016.11
 [C] 2016 Workshop on Stochastic Control and Financial Applications, Hong Kong 2016.08
 [C] Workshop on Random Complex Structures and Data Analysis in Finance, Beijing, China 2016.08

[S] School of Management, University of Science and Technology of China, China	2016.07
[S] School of Statistics, Qufu Normal University, China	2016.07
[S] Systems Engineering and Engineering Management, Chinese University of Hong Kong, HK	2016.06
[S] School of Economics and Management, Tsinghua University, China	2016.06
[C] 2016 Symposium on Financial Engineering and Risk Management, Guangzhou, China	2016.06
[C] 44th Annual Meeting of the Statistical Society of Canada, St. Catharines, Canada	2016.05
[S] Institute of Applied Mathematics, Chinese Academy of Sciences, China	2016.04
[S] School of Mathematical Sciences, Peking University, China	2016.04
[S] China Institute for Actuarial Science, Central University of Finance and Economics, China	2016.03
[S] Department of Mathematics, Beijing Technology and Business University, China	2016.03
2015	
[S] Department of Mathematics, University of Liverpool, UK	2015.12
[S] Cass Business School, UK	2015.12
[S] Vienna Seminar in Mathematical Finance and Probability, Austria	2015.11
[S] Department of Economics, University of Amsterdam, Netherlands	2015.11
[C] Dependence and Risk Measures, Milan, Italy	2015.11
[S] Department of Mathematics, University of Mannheim, Germany	2015.10
[S] Joint Seminar, EPF Lausanne and University of Lausanne, Switzerland	2015.10
[C] The Mathematics and Statistics of Quantitative Risk Management, Oberwolfach, Germany	2015.09
[C] 7th Conference, Advanced Mathematical Methods in Finance, Lausanne, Switzerland	2015.09
[C] Youth Probability Forum, Beijing, China	2015.07
[C] Workshop on Financial and Insurance Risk Management, Beijing, China	2015.07
[C] CORS/INFORMS 2015 Joint International Meeting, Montreal, Canada	2015.06
[S] Department of Statistical Sciences, University of Toronto, Canada	2015.02
2014	
[S] School of Mathematical Sciences, Peking University, China	2014.09
[C] PKU-Math International Workshop on Financial Mathematics, Beijing, China	2014.08
[S] School of Management, University of Science and Technology of China, China	2014.07
[C] International Workshop on Risk Analysis, Ruin and Extremes, Tianjin, China	2014.07

[S] School of Management, Fudan University, China	2014.07
[C] 11th International Vilnius Conference on Probability and Statistics, Vilnius, Lithuania	2014.07
[S] School of Economics and Statistics, University of Milano-Bicocca, Italy	2014.05
[C] Workshop on Recent Developments in Dependence Modeling, Brussels, Belgium	2014.05
[S] Mathematical Statistics and Actuarial Science, University of Bern, Switzerland	2014.05
[S] Department of Mathematics and Statistics, McGill University, Canada	2014.03
[C] 3rd Workshop on Insurance Mathematics, Quebec City, Canada	2014.01
[C] International Workshop on High-Dimensional Dependence and Copulas, Beijing, China	2014.01
2013	
[S] School of Mathematical Sciences, Peking University, China	2013.12
[S] School of Economics and Management, Tsinghua University, China	2013.12
[S] Faculty of Economic and Social Sciences, Vrije Universiteit Brussel (VUB), Belgium	2013.11
[S] Department of Mathematics, ETH Zurich, Switzerland	2013.11
[S] Department of Mathematics and Stochastics, University of Freiburg, Germany	2013.10
[S] Institut de Science Financière et d'Assurances (ISFA), Université Lyon 1, France	2013.10
[C] ICSA - Canada Chapter 2013 Symposium, Toronto, Canada	2013.08
[C] Statistical Science for Society, Waterloo, Canada	2013.07
[C] Young Mathematician Forum (Centennial of Mathematics at Peking University), Beijing, China	2013.06
[S] Institute for Mathematics and its Applications (IMA), Minneapolis, USA	2013.05
[S] Robinson College of Business, Georgia State University, USA	2013.04
[S] School of Mathematics, Georgia Institute of Technology, USA	2013.04
2011 - 2012	
[C] International Conference on Quantitative Finance and Risk Management, Changchun, China	2012.07
[S] School of Mathematics, Georgia Institute of Technology, USA	2011.11
[S] School of Mathematical Sciences, Peking University, China	2011.06

Scientific Service

Affiliated Member

RiskLab, ETH Zurich	2015 - present
Centre for Computational Mathematics, Waterloo	2015 - present
Big Data Research Lab, Waterloo	2014 - present
Waterloo Research Institute in Insurance, Securities and Quantitative Finance	2012 - present

Conference Organizing Committee

Workshop on Risk Measurement and Regulatory Issues in Business, Montreal, Canada	2017.09
Workshop on Random Complex Structures and Data Analysis in Finance, Beijing, China	2016.08
4th Québec-Ontario Workshop on Insurance Mathematics, Waterloo, Canada	2016.02
6th Annual Graduate Student Probability Conference, Georgia Tech, Atlanta, USA	2012.04
5th Annual Graduate Student Probability Conference, Georgia Tech, Atlanta, USA	2011.04

Conference Scientific Committee

6th International Gerber-Shiu Workshop, Beijing, China	2016.06
--	---------

PhD Committee

Xing Wang, Risk Management and Insurance, Georgia State University	defence in 2018
Sajad Shiravi Khozani, Civil and Environmental Engineering, Waterloo	defence in 2018
Edgars Jakobsons, Mathematics, ETH Zurich	defence in 2016
Fangda Liu, Statistics and Actuarial Science, Waterloo	defence in 2015

Peer-review Service

Grant peer-review (total: 2 proposals)

FRQNT Grant (Canada)

NSERC Discovery Grant (Canada)

Journal peer-review (total: 42 journals, 81 papers)

Annals of Actuarial Science	Discrete Optimization
Annals of Operations Research	Economics Bulletin
Annals of the Institute of Statistical Mathematics	Electronic Communications in Probability
Applications of Mathematics	European Journal of Operational Research
ASTIN Bulletin	Extremes
Bernoulli	Finance and Stochastics
Colombian Journal of Statistics	4OR A Quarterly Journal of Operations Research
Communications in Statistics - S&C	Frontiers of Mathematics in China
Computational Statistics	Insurance: Mathematics and Economics
Computational Statistics and Data Analysis	International Statistical Review
Dependence Modeling	Journal of Banking and Finance

Journal of Business and Economic Statistics	Operations Research
Journal of Economic Dynamics and Control	Operations Research Letters
Journal of Multivariate Analysis	Physica A
Journal of Nonparametric Statistics	Quantitative Finance
Journal of Statistical Computation and Simulation	Scandinavian Actuarial Journal
Journal of the Korean Statistical Society	SIAM Journal on Financial Mathematics
Mathematical Finance	Statistics and Probability Letters
Mathematics of Operations Research	Statistics and Risk Modeling
North American Actuarial Journal	Stochastics
North American Journal of Finance and Economics	The American Statistician

Awards

Annual Department Teaching Award, Statistics and Actuarial Science, University of Waterloo	2017
Top Teacher Award, Statistics and Actuarial Science, University of Waterloo	Spring 2015, Fall 2016
Laha Travel Award 2012, Institute of Mathematical Statistics	2012
Bob Price Fellowship, School of Mathematics, Georgia Institute of Technology	2011

Personal

Born in Beijing (1984), citizen of China, permanent resident of Canada

Number of countries visited: 47

Number of continents visited: 6

Number of invited academic talks: 71 (in 13 countries)

Number of courses taught: 13 regular courses, 1 short course, 3 minicourses (in 6 institutions)

Society of Actuaries Exams Passed: P, FM, MLC, MFE and C