Ruodu Wang, Ph.D.

Curriculum Vitae

University Research Chair & 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

University Research Chair, University of Waterloo	2018.07 -
Associate Professor of Actuarial Science (tenured), University of Waterloo	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, *ASTIN Bulletin - The Journal of the International Actuarial Association*	2018 - present
Co-Editor, *European Actuarial Journal*	2016 - present
Associate Editor, *Acta Mathematicae Applicatae Sinica (English Series)*	2016 - present
Member of the Editorial Advisory Board, *Dependence Modeling*	2014 - present

Grants

NSERC Discovery Accelerator Supplement (RGPAS-2018-522590, PI)	2018 - 2021
NSERC Discovery Grant (RGPIN-2018-03823, PI)	2018 - 2023
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	2018.05 - 2018.06
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

Awards

NSERC Discovery Accelerator Supplement Award (125 awardees per year in Canada across all scientific and engineering fields)	2018
University Research Chair, University of Waterloo	2018
The Faculty of Mathematics Golden Jubilee Research Excellence Award, University of Waterloo	2017
Annual Department Teaching Award, Statistics and Actuarial Science, University of Waterloo	2017
Laha Travel Award 2012, Institute of Mathematical Statistics	2012
Bob Price Fellowship, School of Mathematics, Georgia Institute of Technology	2011

Publications and Manuscripts

Refereed Journal Articles

Forthcoming

[43] Shen, J., Shen, Y. and Wang, R. (2018+). Random locations of periodic stochastic processes. *Stochastic Processes and their Applications*, forthcoming.

[42] Puccetti, G., Rigo, P., Wang, B. and Wang, R. (2018+). Centers of probability measures without the mean. *Journal of Theoretical Probability*, forthcoming.

[41] Jakobsons, E. and Wang, R. (2018+). Negative dependence in matrix arrangement problems. *Annals of Operations Research*, forthcoming.

[40] Embrechts, P., Liu, H. and Wang, R. (2018+). Quantile-based risk sharing. *Operations Research*, forthcoming.

2018

[39] Li. L., Shao, H., Wang, R. and Yang, J. (2018). Worst-case Range Value-at-Risk with partial information. *SIAM Journal on Financial Mathematics*, **9**(1), 190–218.

[38] Cai, J., Liu, H. and Wang, R. (2018). Asymptotic equivalence of risk measures under dependence uncertainty. *Mathematical Finance*, **28**(1), 29–49.

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] Embrecths, 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

[11] Wang, R. and Wei, Y. (2018). Characterizing optimal allocations in quantile-based risk sharing.
SSRN: `http://ssrn.com/abstract=3173503`.

[10] Vovk, V. and Wang, R. (2018). Combining p-values via averaging.
SSRN: `http://ssrn.com/abstract=3166304`.

[9] Boonen, T., Liu, F. and Wang, R. (2017). Competitive equilibria in a comonotone market.
SSRN: `http://ssrn.com/abstract=3091424`.

[8] Embrechts, P., Liu, H., Mao, T. and Wang, R. (2017). Quantile-based risk sharing with heterogeneous beliefs.
SSRN: `http://ssrn.com/abstract=3079998`.

[7] Wang, R., Xu, Z. Q. and Zhou, X. Y. (2017). Dual utilities under dependence uncertainty.
SSRN: `http://ssrn.com/abstract=3078374`.

[6] Asimit, V., Peng, L., Wang, R. and Yu, A. (2017). An efficient approach to quantile capital allocation and sensitivity analysis.

[5] Shen, J., Shen, Y., Wang, B. and Wang, R. (2017). Distributional compatibility for change of measures.
arXiv: `https://arxiv.org/abs/1706.01168`.

[4] Wang, R., Wei, Y. and Willmot, G. (2017). Characterization, robustness and aggregation of signed Choquet integrals.
SSRN: `http://ssrn.com/abstract=2956962`.

[3] Mao, T. and Wang, R. (2017). A model-free continuum of degrees of risk aversion.
SSRN: `http://ssrn.com/abstract=2907499`.

[2] Liu, F. and Wang, R. (2016). A theory for measures of tail risk.
SSRN: `http://ssrn.com/abstract=2841909`.

[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 (with G. Willmot) 2015 - present

Jie Shen (with Y. Shen) 2014 - present

Haiyan Liu (with J. Cai) 2013 - 2017

Assistant Professor of Actuarial Science, Michigan State University (2017)

Master's students at the University of Waterloo

Daiwen Dai 2017

Senior Investment Services Specialist, Ontario Teacher's Pension Plan (2018)

Yuchen Zhang 2014

Xiao Jiang (with C. Bernard) 2012 - 2013

Investment Analyst, Canada Pension Plan Investment Board (2014)

Postdoctoral fellows at the University of Waterloo

Daniel Linders (with F. Yang, short term) 2015

Assistant Professor of Actuarial Science, University of Illinois Urbana-Champaign (2017)

Tiantian Mao (with J. Cai and D. Landriault) 2014 - 2015

Associate Professor of Statistics and Finance, University of Science and Technology of China (2017)

Regular Courses

University of Waterloo

ACTSC446/846 - Mathematics of Financial Markets Fall 2014; Winters 2013, 2018

ACTSC625 - Casualty and Health Insurance Mathematics Winters 2013, 2014, 2015, 2017

ACTSC631 - Financial Mathematics III Spring 2015

ACTSC964 - Topics in Quantitative Risk Management Winters 2017, 2018

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 Academic Presentations

Conferences

[23] 8th Conference, Advanced Mathematical Methods in Finance, Amsterdam, Netherlands 2017.06

[22] 4th Workshop on Recent Developments in Dependence Modeling, Aegina, Greece 2017.05

[21] ETH Zurich RiskLab Mini-Workshop, Zurich, Switzerland 2017.04

[20] 2016 Workshop on Stochastic Control and Financial Applications, Hong Kong 2016.08

[19] Workshop on Random Complex Structures and Data Analysis in Finance, Beijing, China 2016.08

[18] 2016 Symposium on Financial Engineering and Risk Management, Guangzhou, China 2016.06

[17] 44th Annual Meeting of the Statistical Society of Canada, St. Catharines, Canada 2016.05

[16] Dependence and Risk Measures, Milan, Italy 2015.11

[15] The Mathematics and Statistics of Quantitative Risk Management, Oberwolfach, Germany 2015.09

[14] 7th Conference, Advanced Mathematical Methods in Finance, Lausanne, Switzerland 2015.09

[13] Youth Probability Forum, Beijing, China 2015.07

[12] Workshop on Financial and Insurance Risk Management, Beijing, China 2015.07

[11] CORS/INFORMS 2015 Joint International Meeting, Montreal, Canada 2015.06

[10] PKU-Math International Workshop on Financial Mathematics, Beijing, China 2014.08

[9] International Workshop on Risk Analysis, Ruin and Extremes, Tianjin, China 2014.07

[8] 11th International Vilnius Conference on Probability and Statistics, Vilnius, Lithuania 2014.07

[7] Workshop on Recent Developments in Dependence Modeling, Brussels, Belgium 2014.05

[6] 3rd Workshop on Insurance Mathematics, Quebec City, Canada 2014.01

[5] International Workshop on High-Dimensional Dependence and Copulas, Beijing, China 2014.01

[4] ICSA - Canada Chapter 2013 Symposium, Toronto, Canada 2013.08

[3] Statistical Science for Society, Waterloo, Canada 2013.07

[2] Young Mathematician Forum (Centennial of Mathematics at Peking University), Beijing, China 2013.06

[1] International Conference on Quantitative Finance and Risk Management, Changchun, China 2012.07

Seminars and Colloquia

[52] Department of Mathematics, Ryerson University, Canada 2018.04

[51] School of Operations Research and Information Engineering, Cornell University, USA 2018.02

[50] Department of Pure Mathematics, University of Waterloo, Canada 2018.01

[49] Department of Risk and Insurance, University of Wisconsin-Madison, USA 2017.12

[48] Department of Mathematics, University of Connecticut, USA 2017.11

[47] School of Mathematics and Statistics, Wuhan University, China 2017.11

[46] Lab of Earth Surface Processes and Resource Ecology, Beijing Normal University, China 2017.11

[45] School of Statistics, Qufu Normal University, China 2017.11

[44] School of Management, University of Science and Technology of China, China 2017.10

[43] Institute of Applied Mathematics, Chinese Academy of Sciences, China 2017.10

[42] School of Mathematical Sciences, Peking University, China 2017.07

[41] Department for Mathematics, University of Salzburg, Austria 2017.06

[40] School of Economics and Statistics, University of Milano-Bicocca, Italy 2017.05

[39] Department of Mathematics, Ryerson University, Canada 2017.04

[38] Actuarial School, Laval University, Canada 2017.03

[37] Department of Statistics, University of Michigan, USA 2016.11

[36] Robinson College of Business, Georgia State University, USA 2016.11

[35] School of Management, University of Science and Technology of China, China 2016.07

[34] School of Statistics, Qufu Normal University, China 2016.07

[33] Systems Engineering and Engineering Management, Chinese University of Hong Kong, HK 2016.06

[32] School of Economics and Management, Tsinghua University, China 2016.06

[31] Institute of Applied Mathematics, Chinese Academy of Sciences, China 2016.04

[30] School of Mathematical Sciences, Peking University, China 2016.04

[29] China Institute for Actuarial Science, Central University of Finance and Economics, China 2016.03

[28] Department of Mathematics, Beijing Technology and Business University, China 2016.03

[27] Department of Mathematics, University of Liverpool, UK 2015.12

[26] Cass Business School, City University London, UK 2015.12

[25] Vienna Seminar in Mathematical Finance and Probability, Austria 2015.11

[24] Department of Economics, University of Amsterdam, Netherlands 2015.11

[23] Department of Mathematics, University of Mannheim, Germany 2015.10

[22] Joint Seminar, EPF Lausanne and University of Lausanne, Switzerland 2015.10

[21] Department of Statistical Sciences, University of Toronto, Canada 2015.02

[20] School of Mathematical Sciences, Peking University, China 2014.09

[19] School of Management, University of Science and Technology of China, China 2014.07

[18] School of Management, Fudan University, China 2014.07

[17] School of Economics and Statistics, University of Milano-Bicocca, Italy 2014.05

[16] Mathematical Statistics and Actuarial Science, University of Bern, Switzerland 2014.05

[15] Department of Mathematics and Statistics, McGill University, Canada 2014.03

[14] School of Mathematical Sciences, Peking University, China 2013.12

[13] School of Economics and Management, Tsinghua University, China 2013.12

[12] Faculty of Economic and Social Sciences, Vrije Universiteit Brussel (VUB), Belgium 2013.11

[11] Department of Mathematics, ETH Zurich, Switzerland 2013.11

[10] Department of Mathematics and Stochastics, University of Freiburg, Germany 2013.10

[9] Institut de Science Financière et d'Assurances (ISFA), Université Lyon 1, France 2013.10

[8] Institute for Mathematics and its Applications (IMA), Minneapolis, USA 2013.05

[7] Robinson College of Business, Georgia State University, USA 2013.04

[6] School of Mathematics, Georgia Institute of Technology, USA 2013.04

[5] Department of Statistics and Actuarial Science, University of Waterloo, Canada 2012.02

[4] Department of Mathematics, Illinois State Unviersity, USA 2012.02

[3] Department of Mathematics, Northern Illinois University, USA 2012.01

[2] School of Mathematics, Georgia Institute of Technology, USA 2011.11

[1] School of Mathematical Sciences, Peking University, China 2011.06

Scientific Service

Affiliated Member

Waterloo Artificial Intelligence Institute 2018 - present
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

Ahmed Abdalrahman, Electrical and Computer Engineering, Waterloo
Sajad Shiravi Khozani, Civil and Environmental Engineering, Waterloo
Edgars Jakobsons, Mathematics, ETH Zurich defended in 2016
Fangda Liu, Statistics and Actuarial Science, Waterloo defended in 2015

Peer-review Service

Grant peer-review (total: 2 proposals)

FRQNT Grant (Canada)
NSERC Discovery Grant (Canada)

Journal peer-review (total: 46 journals, 90 papers)

Annals of Actuarial Science
Annals of Operations Research
Annals of the Institute of Statistical Mathematics
Applications of Mathematics
ASTIN Bulletin
Bernoulli
Colombian Journal of Statistics
Communications in Statistics - Simul. & Comp.
Computational Statistics
Computational Statistics and Data Analysis
Dependence Modeling
Discrete Optimization
Economics Bulletin
Electronic Communications in Probability
European Actuarial Journal
European Journal of Operational Research
Extremes
Finance and Stochastics
4OR A Quarterly Journal of Operations Research
Frontiers of Mathematics in China
Insurance: Mathematics and Economics
International Statistical Review
Journal of Banking and Finance
Journal of Business and Economic Statistics
Journal of Economic Dynamics and Control
Journal of Multivariate Analysis
Journal of Nonparametric Statistics
Journal of Risk and Insurance
Journal of Statistical Computation and Simulation
Journal of the Korean Statistical Society
Journal of the Royal Statistical Society - Series A
Mathematical Finance
Mathematics of Operations Research
North American Actuarial Journal
North American Journal of Finance and Economics
Operations Research

Operations Research Letters
Physica A
Quantitative Finance
Risks
Scandinavian Actuarial Journal
SIAM Journal on Financial Mathematics
Statistics and Probability Letters
Statistics and Risk Modeling
Stochastics
The American Statistician

Personal

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

Number of countries visited: 48

Number of continents visited: 6

Number of invited academic talks: 75 (in 13 countries)

Number of courses taught: 15 regular courses, 1 short course, 3 minicourses (in 6 institutions)

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

Erdös Number: 3 (Ruodu Wang ← Ričardas Zitikis ← Endre Csáki ← Paul Erdös)
