

# **On a Class of Premium Calculation Principles Based on the Multivariate Weighted Distribution: Theory and Application**

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## **Abstract**

This paper proposes a new class of premium calculation principles based on the multivariate weighted distribution (MWPP), where risk loadings are imposed by transforming the density of the original underlying risk with some external factors. This premium principle has a number of desirable characteristics, including scale and translation invariance, additivity, stochastic dominance preserving, and additivity for layers. It is also shown that by appropriately selecting external risk factors, this premium principle has increasing relative risk loading. This premium principle is important for actuarial pricing practice in the sense that it is flexible to integrate additional important information, such as market conditions, economic conditions, catastrophic events, etc., into the pricing framework. We highlight the empirical usefulness of this new premium principle by using a unique data set comprised of agricultural reinsurance experience in Manitoba, Canada. The results show that integrating external risk factors into the pricing framework improves the accuracy of the rating by redistributing premium rates and assigning higher loadings to riskier reinsurance contract layers, helping reinsurers to achieve better sustainability in the long term.

## **Bio**

Dr. Wenjun Zhu (Ph.D., ASA, CERA) is currently an Assistant Professor in Nanyang Business School at Nanyang Technological University. She received her Ph.D. in the Department of Statistics and Actuarial Science, University of Waterloo, Canada, in 2015. As the first student admitted to the PhD program without a Master's degree in the department, Dr. Zhu holds double Bachelor's degree in Economics and Mathematics. She is also twice a winner of the Society of Actuaries James C. Hickman Scholar (2013-14, 2014-15). Before joining NBS, she served as an Assistant Professor from 2015-2017 in the School of Finance at Nankai University, China.

Dr. Zhu has been publishing in the Journal of Risk and Insurance, North American Actuarial Journal, ASTIN Bulletin, Journal of Banking and Finance, etc. Currently, she is particularly interested in research topics including systemic risks in finance and insurance, commodity futures market, actuarial ratemaking in agricultural insurance, high dimensional modeling with copulas, and longevity risk management.