学校编码：10384

学号：15420141152001

厦门大学

硕士学位论文

基于序贯蒙特卡罗方法的边际期望损失测度

Marginal Expected Shortfall Measurement based on Sequential Monte Carlo Method

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专业名称：统计学

答辩日期：2017年4月

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摘 要

2008金融危机的爆发令各国的金融监管机构意识到金融体系中系统性风险的重要性，也使得系统性风险方面的研究成为学者们关注的热点。要有效加强对系统性风险的监管，必须以能够有效识别并科学测度系统性风险为前提。边际期望损失(MES，Marginal Expected Shortfall)是由Acharya et al. (2011)提出的一种金融系统性风险测度的新方法。MES是指在市场收益率出现大幅下跌时，某单个金融机构的系统性风险贡献，该指标可用于确定公司在金融危机中将面临的资本损失。相应的长期指标为长期边际期望损失(LRMES)，即未来一段较长时间内，市场股票价格指数下跌大于某一阈值时单个金融机构的系统性风险贡献。

由于LRMES的计算涉及高维积分，难以得到精确的解析解，Brownlees and Engle(2012)通过拒绝抽样的方法计算LRMES的值。然而，当下跌阈值较大时，事件发生的概率较小，该方法的抽样效率会非常低。因此，考虑采用序贯重要性抽样方法计算LRMES。具体而言，本文采用序贯重要性抽样方法以提高样本的接受概率，解决上述有效样本比率过低的问题。然而在序贯重要性抽样过程中，某些样本分量会发生严重偏斜，导致其对最终样本估计量(LRMES)的贡献微乎其微，实际有效样本量减少。因此，本文考虑采用带重抽样的序贯重要性抽样方法来提高实际有效样本数量。同时，由于重抽样系数的计算涉及高维积分，本文采用模拟导频样本的方法算得该重抽样系数。模拟结果显示，序贯重要性抽样可以有效提高样本接受概率；基于导频的重抽样方法可以增加有效样本数量，并提高样本估计量的准确性。

关键词：长期边际期望损失；序贯重要性抽样；重抽样；导频

Abstract

The outbreak of the financial crisis makes the financial regulators of many countries aware of the importance of systemic risk in the financial system, which also makes researchers interested in systemic risk. In order to effectively strengthen the regulation of systemic risk, we must be able to effectively identify and scientifically measure systemic risk as a prerequisite.Marginal Expected Shortfall is a new method to measure the financial systemic risk proposed by Acharya et al. (2011). After the financial crisis in 2008, this measure has been widely used. MES is the expected loss an equity investor in a financial firm would experience if the overall market declined substantially, which can be used to determine the capital loss that the company will face in a financial crisis. The corresponding long-term indicator is the Long Run Marginal Expected Shortfall (LRMES), the systemic risk contribution of a single financial institution when the market stock price index falls more than a certain threshold over a long period of time.

Brownlees and Engle (2012) calculate LRMES through rejection method. However, when the threshold is large, the sampling efficiency of the method will be very low. Therefore, this paper adopted Sequential Importance Sampling method to calculate LRMES.To be specific, this paper uses Sequential Importance Sampling method to improve the acceptance probability of the sample and solve the problem that the effective sample ratio is too low. In the sequential importance sampling process, some partial samples are seriously skewed, resulting in minimal contribution to the sample estimation (LRMES), the number of practical effective samples decreases. Therefore, this paper considers the Sequential Importance Sampling with Resampling method to improve the number of practical effective samples. At the same time, since the calculation of the weight involves high dimensional integral, this paper calculates the weight by

generating pilots. The simulation results show that the Sequential Importance Sampling method can effectively improve the probability of sample acceptance. Resampling method guided by pilots can increase the number of practical effective samples and improve the accuracy of sample estimation.

Keywords: LRMES; Sequential Improtance Sampling; Resampling; Pilots

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