Supply Chains Involving a Mean-Variance-Skewness-Kurtosis Newsvendor: Analysis and Coordination

by

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Abstract:

The classical newsvendor problem seeks to minimize the expected inventory cost or maximize the expected profit. But optimizing an expected value alone does not fully capture the stochastic nature of the newsvendor problem. Inspired by the higher-moment analyses explored in finance, we conduct a mean-variance-skewness-kurtosis (MVSK) analysis for the newsvendor problem. We first derive the analytical expressions for the profit's mean, variance, skewness, and kurtosis in the standard newsvendor setting, and reveal their structural properties. We then establish various MVSK optimization problems and find the solution to each of them. We show that kurtosis aversion always induces the newsvendor to order less, while skewness seeking can induce the newsvendor to order either more or less depending on the specific structure of the profit's skewness, which is affected by the symmetric and asymmetric properties of the demand distribution. Finally, based on the Pareto-optimality concept, we address the challenge of supply chain coordination (SCC) in the presence of MVSK agents in two specific cases: (i) each agent maximizes its MVSK-objective-function and (ii) each agent maximizes its expected profit function, subject to given constraints on the profit's variance, skewness, and kurtosis. In each case, we explore whether and how the supply chain can be coordinated. We find that considering the MVSK preferences of supply chain agents will affect the achievability of SCC and flexibility of the coordinating contract. We also uncover that if we assume an individual MVSK agent to be an MV one, the achievability of SCC by contracts will be very much negatively affected.

Keywords: finance-operations interface; risk analysis; decision analysis; supply chain coordination

Bio:

Prof. Suresh P. Sethi is Eugene McDermott Professor of Operations Management and Director of the Center for Intelligent Supply Networks at The University of Texas at Dallas. He has written 7 books and published over 400 research papers in the fields of manufacturing and operations management, finance and economics, marketing, and optimization theory. He teaches a course on optimal control theory/applications and organizes a seminar series on operations management topics. He initiated and developed the doctoral programs in operations management at both University of Texas at Dallas and University of Toronto. He serves on the editorial boards of several journals including Production and Operations Management and SIAM Journal on Control and Optimization. He was named a Fellow of The Royal Society of Canada in 1994. Two conferences were organized and two books edited in his honor in 2005-6. Other honors include: IEEE Fellow (2001), INFORMS Fellow (2003), AAAS Fellow (2003), POMS Fellow (2005), IITB Distinguished Alum (2008), SIAM Fellow (2009), POMS President (2012), INFORMS Fellows Selection Committee (2014-16), Alumni Achievement Award, Tepper School of Business, Carnegie Mellon University (2015).

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All are welcome!