Pricing Spread Options by Generalized Bivariate Edgeworth Expansion

EDWARD P. C. KAO* and WEIWEI XIE‡

†Department of Mathematics, University of Houston,
Houston,Texas, 77204, U.S.A.

‡Department of Mathematical Sciences, Worcester Polytechnic Institute,
Worcester, Masschuesetts, 01605, U.S.A.

A spread option is a contingent claim whose underlying is the price difference between two assets. For a call, the holder of the option receives the difference, if positive, between the price difference and the strike price. Otherwise, the holder receives nothing. Spread options trade in large volume in financial, fixed-income, commodity, and energy industries. It is well known that pricing of spread options does not admit closed-form solutions even under a geometric Brownian motion paradigm. When price dynamics experience stochastic volatilities and/or jumps, the valuation process becomes more challenging. Following the seminal work of Jarrow and Judd, we propose the use of Edgeworth expansion to approximate the call price. In the spirit of Pearson, we reduce the cumbersome computation inherent in Edgeworth expansion to single numerical integrations. For an arbitrary bivariate price process, we show that once its product cumulants are available, either by virtue of the structural properties of the underlying processes or by empirical estimation using market data, the approach enables analysts to approximate the call price easily. Specifically, the call prices so estimated capture the correlation, skewness, and kurtosis of the two underlying price processes.