Option Price Modeling via Extended Marshall-Olkin Distributions

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The joint distribution of the random vector (X_1, X_2) meets the classical Marshall-Olkin model whenever

$$(X_1, X_2) = (\min(T_1, T_3), \min(T_2, T_3)),$$

where T_i are independent and exponentially distributed random variables, $i = 1, 2, 3$.

The independence assumption between T_1 and T_2 (treated as individual shocks) in the Marshall-Olkin model is a serious restriction and may not be always satisfied in practice. It is reasonable to assume that T_3 (interpreted as a common fatal shock) is independent of T_1 and T_2, which are no more independent but defined by their joint survival function $S_{T_1,T_2}(x_1, x_2) = P(T_1 \geq x_1, T_2 \geq x_2)$.

Pinto (2014) [PhD Thesis, IME-USP] introduced the Extended Marshall-Olkin model by its survival function

$$S_{X_1,X_2}(x_1, x_2) = S_{T_1,T_2}(x_1, x_2) S_{T_3}(\max\{x_1, x_2\}), \quad \text{for all} \quad x_1, x_2 \geq 0,$$

where $S_{T_3}(.)$ is the survival function of T_3.

We will apply the Extended Marshall-Olkin model to depict interactions between option prices in a real data set. A comparison with earlier analyses will be provided as well.