On stability of call/put option prices in incomplet models under statistical estimations

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Abstract

We consider a semimartingale models of risky asset $S = (S_t)_{t\geq 0}$ of the type

$$S_t = S_0 \exp(X_t)$$

where $X = (X_t)_{t\geq 0}$ is a semimartingale with the law depending on unknown parameter $\theta,\ \theta \in \Theta$. The value process of the bond supposed to be given by $B_t = \exp(rt)$ where r is a positive constant.

The classical procedure of pricing of call/put option of maturity T consists to choose the type of option, given by a continuous in the space $D([0,T[)$ functional and, then, one equivalent martingale measure Q belonging to the class of equivalent martingale measures, supposed non-empty, and put

$$\mathfrak{C}_T(\theta) = \mathbb{E}_Q[\exp(-rt)g(S)]$$

Since the price depend on unknown parameter we replace θ in the above expression by its estimator $\hat{\theta}$ which gives a new price $\mathfrak{C}_T(\hat{\theta})$.

We prove the inequalities for L^1-distance between $\mathfrak{C}_T(\theta)$ and $\mathfrak{C}_T(\hat{\theta})$ and we find the conditions for the stability of prices under statistical estimation. We give also the results for important particular case of Levy processes. To illustrate the results, we apply them in the case of GVG and CGMY models.