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Corrigendum

Corrigendum to "Martingale optimal transport in the Skorokhod space" [Stochastic Process. Appl. 125(10) (2015) 3893–3931]

Yan Dolinsky[a], H. Mete Soner[b,*]

[a] *Department of Statistics, Hebrew University of Jerusalem, Israel*
[b] *Department of Mathematics, ETH Zurich & Swiss Finance Institute, Switzerland*

In the Section 3.1 of that paper, we have defined a sequence of hitting times recursively by, $\tau_0 = 0$ and for $k > 0$,

$$\tau_{k+1} := T \wedge \left(\tau_k + \sqrt{d}2^{-n}\right) \wedge \inf\left\{t > \tau_k : \mathbb{S}_t \notin O(\mathbb{S}_{\tau_k}, n)\right\}.$$

Implicitly, we have used that they are stopping times with respect to the natural filtration $(\mathcal{F}_t = \sigma\{\mathbb{S}_u : u \leq t\}, t \geq 0)$ generated by $\mathbb{S}$. However, in general, this statement is not correct. In the classical theory, they become stopping times only after one competes the filtration using a given probability measure. For details, one refer to [1] (Chapter 4, Section 3). Since it is essential in our paper that no fixed probability measure is used and the filtration is not completed, we need to replace these random times by a sequence of stopping times.

This is achieved easily as follows. Indeed, set $\tau_0 = 0$ and for $k > 0$,

$$\tau_{k+1} := T \wedge \left(\tau_k + \sqrt{d}2^{-n}\right) \wedge \inf\left\{t > \tau_k : \mathbb{S}_t \notin O(\mathbb{S}_{\tau_k}, n) \text{ or } \mathbb{S}_{t-} \notin O(\mathbb{S}_{\tau_k}, n)\right\}.$$

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* Corresponding author.
E-mail address: mete.soner@math.ethz.ch (H.M. Soner).

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The above random times are stopping times with respect to the natural filtration. Indeed, observe that for $t < T$,

$$\{\tau_{k+1} \le t\} = \left\{\max(t - \tau_k, |\mathbb{S}_t - \mathbb{S}_{\tau_k}|) \ge \sqrt{d}2^{-n}\right\}$$
$$\cup \left(\bigcap_{m=1}^{\infty} \bigcup_{q<t} \left\{|\mathbb{S}_q - \mathbb{S}_{q\wedge\tau_k}| > \sqrt{d}2^{-n} - 1/m\right\}\right)$$

where q denotes a rational number. Thus by induction, if τ_k is a stopping time, in order to show that τ_{k+1} is a stopping time it remains to establish that for any $q < t$, $\mathbb{S}_{q\wedge\tau_k}$ is $\mathcal{F}_t$ measurable. This follows from the fact that for any $a \in \mathbb{R}$

$$\{\mathbb{S}_{q\wedge\tau_k} > a\} = \bigcup_{r=1}^{\infty} \bigcap_{m=1}^{\infty} \bigcup_{q'<t} \left(\{q' - 1/m < q \wedge \tau_k < q'\} \cap \{\mathbb{S}_{q'} > a + 1/r\}\right) \in \mathcal{F}_t$$

where q' denotes a rational number.

We modify the random times $\tau_k^{(j)}$ in Section 5.1 similarly.

In all other places, we deal only with piecewise constant processes with a finite (random) number of jumps. Consequently, all the defined hitting times are stopping times with respect to the natural filtration.

This modification leaves all the arguments (in particular, the lifting argument) unchanged.

References

[1] C. Dellacherie, P.A. Meyer, Probabilities and Potential A, Hermann, Paris, 1978.

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