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Two fixed point theorems in complete random normed modules and their applications to backward stochastic equations. (English) Zbl 07153748

Summary: Let \((\Omega, \mathcal{F}, \mathcal{F}, \mathcal{P})\) be a filtered probability space with a filtration \(\mathcal{F} = (\mathcal{F}_t)_{t \in [0,T]}\) satisfying the usual conditions and \(T\) a finite time, \(L^{0}(\mathcal{F}_0)\) the algebra of equivalence classes of \(\mathcal{F}_0\)-measurable real-valued random variables on \(\Omega\), \(L^{p}(\mathcal{F}_T, \mathbb{R}^d)\) the usual function space and \(L^{p}_{\mathcal{F}_0}(\mathcal{F}_T, \mathbb{R}^d)\) the \(L^{0}(\mathcal{F}_0)\)-module generated by \(L^{p}(\mathcal{F}_T, \mathbb{R}^d)\). The usual backward stochastic equations (BSEs) are studied for their terminal conditions \(\xi\) in \(L^{p}(\mathcal{F}_T, \mathbb{R}^d)\). Motivated by the study of continuous-time conditional mean-conditional convex risk measure portfolio selection, this paper, for the first time, formulates and studies a more general class of BSEs with their terminal conditions in \(L^{p}_{\mathcal{F}_0}(\mathcal{F}_T, \mathbb{R}^d)\). The main results of this paper are to prove two fixed point theorems in complete random normed modules, which are respectively the random generalizations of Banach contraction mapping principle and Browder-Kirk fixed point theorem, and give their applications to the general class of BSEs.

MSC:
60-XX Probability theory and stochastic processes
46-XX Functional analysis

Keywords:
complete random normed modules; fixed point theorems; backward stochastic equations; backward stochastic differential equations

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