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A New Class of Backward Stochastic Partial Differential Equations with Jumps and Applications

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We formulate a new class of stochastic partial differential equations (SPDEs), named high-order vector backward SPDEs (B-SPDEs) with jumps, which allow the high-order integral-partial differential operators into both drift and diffusion coefficients. Under certain type of Lipschitz and linear growth conditions, we develop a method to prove the existence and uniqueness of adapted solution to these B-SPDEs with jumps. Comparing with the existing discussions on conventional backward stochastic (ordinary) differential equations (BSDEs), we need to handle the differentiability of adapted triplet solution to the B-SPDEs with jumps, which is a subtle part in justifying our main results due to the inconsistency of differential orders on two sides of the B-SPDEs and the partial differential operator appeared in the diffusion coefficient. In addition, we also address the issue about the B-SPDEs under certain Markovian random environment and employ a B-SPDE with strongly nonlinear partial differential operator in the drift coefficient to illustrate the usage of our main results in finance.

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