

Definition 0.0.1 (Ito's integral, multidimensional). Let $\gamma \in L_W(\mathbb{P})$, that is, γ is an \mathbb{R}^d -valued \mathcal{F} -progressively measurable process satisfying

$$\mathbb{P}\left(\int_0^T |\gamma_u|^2 \, du < \infty\right) = 1,$$

where $|\cdot|$ stands for the Euclidean norm in \mathbb{R}^d . Then the Ito stochastic integral of γ w.r.t. W is well defined and for any $t \in [0, T]$,

$$I_t(\gamma) = \int_0^t \gamma_u \cdot dW_u = \sum_{i=1}^d \int_0^t \gamma_u^i \, dW_u^i.$$