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measurability of stochastic processes

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For a continuous-time stochastic process adapted to a given http://planetmath.org/Filtrati $(\mathcal{F}_t)_{t\in\mathbb{R}_+}$ on a measurable space $(\Omega,\mathcal{F})$, there are various conditions which can be placed either on its sample paths or on its measurability when considered as a function from $\mathbb{R}_+\times\Omega$ to $\mathbb{R}$. The following theorem lists the dependencies between these properties.

Theorem. *Let $(X_t)_{t\in\mathbb{R}_+}$ be a real valued stochastic process. Then, X is optional if it is adapted and right-continuous, it is predictable if it is adapted and left-continuous. Furthermore, each of the following properties implies the next.*

1. *X is predictable.*
2. *X is optional.*
3. *X is progressive.*
4. *X is adapted and jointly measurable.*