measurability of stopped processes

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Let X be a real-valued stochastic process and τ be a stopping time. If X satisfies any of the following properties then so does the stopped process X^τ.

1. X is jointly measurable.

2. X is progressively measurable.

3. X is optional.

4. X is predictable.

In particular, if X is a right-continuous and adapted process then it is progressive (alternatively, it is optional). Then, the stopped process X^τ will also be progressive and is therefore right-continuous and adapted.

Also, for any progressive process X and bounded stopping time $\tau \leq t$, the above result shows that $X_\tau = X_t^\tau$ will be $\mathcal{F}_t$-measurable.