Homework One: Galton-Watson processes

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Excise 1 For any $k \geq 2$, please find some suitable conditions such that

$$\mathbb{E}[|Z_n|^k] < \infty.$$

Moreover, please find a upper bound function $C(n)$ such that

$$\mathbb{E}[|Z_n|^k] < C(n), \quad \forall n \geq 1.$$

Excise 2 For any $t \in [0, 1]$, we have $f_n(s) \to q$ as $n \to \infty$.

Excise 3 Actually, $\mathbb{E}[|\xi|^2] < \infty$ is not necessary for the second result in Theorem 1.5. Please find some weaker conditions.

Excise 4 According to Theorem 1.6, please give a new way to reconstruct super-critical GW-processes. *Hint: Using Z_n^* and $\{Z_n|\tau_0 < \infty\}$*