Renorming divergent perpetuities

Paweł Hitczenko, Jacek Wesołowski

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We consider a sequence of random variables (R_n) defined by the recurrence $R_n=Q_n+M_nR_{n-1}$, $n\ge1$, where R_0 is arbitrary and (Q_n,M_n), $n\ge1$, are i.i.d. copies of a two-dimensional random vector (Q,M), and (Q_n,M_n) is independent of R_{n-1}. It is well known that if $E{\ln}|M|<0$ and $E{\ln^+}|Q|<\infty$, then the sequence (R_n) converges in distribution to a random variable R given by $R\stackrel{d}{=}\sum_{k=1}^{\infty}Q_k\prod_{j=1}^{k-1}M_j$, and usually referred to as perpetuity. In this paper we consider a situation in which the sequence (R_n) itself does not converge. We assume that $E{\ln}|M|$ exists but that it is non-negative and we ask if in this situation the sequence (R_n), after suitable normalization, converges in distribution to a non-degenerate limit.

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