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A Characterization of a New Type of Strong Law of Large Numbers

Let $0 < p < 2$ and $1 \leq q < \infty$. Let $\{X_n;\ n \geq 1\}$ be a sequence of independent copies of a real-valued random variable X and set $S_n = X_1 + \cdots + X_n,\ n \geq 1$. We say X satisfies the (p, q)-*type strong law of large numbers* (and write $X \in SLLN(p, q)$) if $\sum_{n=1}^{\infty} \frac{1}{n} \left(\frac{|S_n|}{n^{1/p}} \right)^q < \infty$ almost surely. This talk is devoted to a characterization of $X \in SLLN(p, q)$. By applying results obtained from the new versions of the classical Lévy, Ottaviani, and Hoffmann-Jørgensen (1974) inequalities proved by Li and Rosalsky (2013) and by using techniques developed by Hechner (2009) and Hechner and Heinkel (2010), we obtain sets of necessary and sufficient conditions for $X \in SLLN(p, q)$ for the six cases: $1 \leq q < p < 2$, $1 < p = q < 2$, $1 < p < 2$ and $q > p$, $q = p = 1$, $p = 1 < q$, and $0 < p < 1 \leq q$. The necessary and sufficient conditions for $X \in SLLN(p, 1)$ have been discovered by Li, Qi, and Rosalsky (2011). Versions of above results in a Banach space setting are also given. Illustrative examples are presented.