The weak law of Large Numbers

Let $X_1, X_2, \ldots$ be a sequence of independent r.v., each having the same mean μ and having finite variance. Then

$$\bar{X}_n = \frac{1}{n}\sum_{i=1}^{n} X_i$$

$\forall \varepsilon > 0$, we have that

$$\lim_{n \to \infty} P\left(|\bar{X}_n - \mu| \geq \varepsilon \right) = 0, \quad \mu \stackrel{!}{=} E[X_i]$$

That is that the sample averages converge in probability to the common (population) mean μ.

Proof: using Chebychev's inequality.

Convergence in probability is "weaker" than almost sure convergence (strong LLN).
Not all X_i are "almost sure" to converge but the sample mean, for "n" large.

Reference: Probability and Statistics, 2nd ed., Michael J. Evans and Jeffrey S. Rosenthal, 2009.