Inference Cheatsheet

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1 Convergence in Probability

Definition 1 (Convergence in Probability)**.** $Y_n \xrightarrow{p} c$ if for every $\epsilon > 0$ and $\delta > 0$, $\exists\ n_0(\epsilon, \delta)$ such that $\forall n > n_0(\epsilon, \delta)\ P(|Y_n - c| > \epsilon) < \delta$.

Theorem 1 (Chebyshev Inequality)**.** For random variable, Y, $a > 0$, and c,

$$P(|Y - c| \geq a) \leq \frac{\mathbf{E}(Y - c)^2}{a^2} \tag{1}$$

Definition 2 (Markov Inequality)**.** If X is a nonnegative random variable and $a > 0$ then

$$P(X \geq a) \leq \frac{\mathbf{E}X}{a} \tag{2}$$

Theorem 2. If $\mathbf{E}(Y - c)^2 \to 0$, then $Y_n \xrightarrow{p} c$.

Theorem 3. If $X_1, \ldots, X_n$ iid, $\mathbf{E}X_i = \mu$, $\mathbf{Var}X_i = \sigma^2 < \infty$, then

$$\bar{X} \xrightarrow{p} \mu \tag{3}$$