Inequalities

1. Markov's Inequality: If $X \geq 0$ and $a > 0$, then $P(X \geq a) \leq \frac{E(x)}{a}$

   (Only for non-negative)

   e.g. $X \geq 0$. $E(x) = 5$.

   $$P(X \geq 100) \leq \frac{E(x)}{a} = \frac{5}{100} = 0.05.$$

2. Chebychev's Inequality. For any $a > 0$, $P(|Y - \mu_Y| \geq a) \leq \frac{Var(Y)}{a^2}$.

   proof: $P(|Y - \mu_Y| \geq a) = P((Y - \mu_Y)^2 \geq a^2) \leq \frac{E[(Y - \mu_Y)^2]}{a^2} = \frac{Var(Y)}{a^2}$.

   e.g. $\mu_Z = 5$. $Var(2) = 9$.

   $$P(Z \geq 17) = P(2 - 5 \geq 12) \leq \frac{Var(2)}{12^2} = \frac{9}{144}$$