$$\bar{X} = \frac{1}{n}\sum_{i=1}^{n} X_i \qquad X_1, X_2 \cdots X_n \sim Normal(\mu, \sigma^2)$$

$$\mathbb{E}[\bar{X}] = \mu \qquad Var[\bar{X}] = \frac{\sigma^2}{n} \qquad Var(X) = \mathbb{E}[(X-\mu)^2]$$

Sample standard deviation, S.

$$S^2 = \frac{1}{n-1}\sum_{i=1}^{n}(X_i - \bar{X})^2 \qquad \mathbb{E}(S^2) = \sigma^2 \qquad se(\bar{X}) = \frac{S}{\sqrt{n}}$$

$X_1, X_2 \cdots X_n \sim Binomial(n, p)$.

$$X_i \sim Ber(p) \qquad X = \sum_{i=1}^{n} X_i \sim Binomial(n, p) \qquad \frac{X - np}{\sqrt{np(1-p)}} \sim Normal(0,1)$$

$$Y \sim Poisson(n\lambda)$$

$$\bar{P} = \frac{X}{n} \qquad \mathbb{E}[\bar{P}] = \mathbb{E}\left[\frac{X}{n}\right] = \frac{1}{n}\mathbb{E}[X] = \frac{np}{n} = p \qquad \frac{Y - n\lambda}{\sqrt{n\lambda}} \sim Normal(0,1)$$

$$Var(\bar{P}) = \frac{p(1-p)}{n}$$

$$\varepsilon > 0. \quad \lim_{n\to\infty}(\mathbb{P}(|T(X) - \theta| < \varepsilon)) = 1 \qquad \lim_{n\to\infty}(\mathbb{P}(|T(X) - \theta| > \varepsilon)) = 0$$

$$T(X) = \bar{X} = \frac{1}{n}\sum_{i=1}^{n} X_i$$

$\mathbb{P}(Y \geq C) \leq \mathbb{E}[Y]/C$ Law of Large Number

$$\mathbb{P}(|X - \mu| \geq \varepsilon) = \mathbb{P}((X-\mu)^2 \geq \varepsilon^2) \leq \frac{\mathbb{E}[(X-\mu)^2]}{\varepsilon^2} = \cancel{\frac{\sigma^2}{\varepsilon^2}} \frac{Var(X)}{\varepsilon} = \frac{\sigma^2}{\varepsilon}$$

$$\mathbb{P}(|\bar{X} - \mu| \geq \varepsilon) = \mathbb{P}((\bar{X}-\mu)^2 \geq \varepsilon^2) \leq \frac{\mathbb{E}[(\bar{X}-\mu)^2]}{\varepsilon^2} = \frac{\sigma^2}{n\varepsilon^2}$$

$$\frac{\bar{X} - \mu}{\sqrt{\frac{\sigma^2}{n}}} \sim Normal(0,1). \qquad \lim_{n\to+\infty}\mathbb{P}\left(\frac{\bar{X}-\mu}{\sqrt{\frac{\sigma^2}{n}}} \leq x\right) = \Phi(x).$$

$$\mathbb{P}\left\{-z_{\frac{\alpha}{2}} < \frac{\bar{X}-\mu}{\sqrt{\frac{\sigma^2}{n}}} < z_{\frac{\alpha}{2}}\right\} = 1-\alpha. \quad 原\ \mathbb{P}\left\{z_{\frac{\alpha}{2}} < \frac{\bar{X}-\mu}{\sqrt{\frac{\sigma^2}{n}}} < z_{1-\frac{\alpha}{2}}\right\} = 1-\alpha$$

$$\mu = \boxed{\bar{X} \pm z_{\frac{\alpha}{2}}\left(\sqrt{\frac{\sigma^2}{n}}\right)} \quad 写要写\ z_{1-\frac{\alpha}{2}} \qquad \frac{\bar{X}-\mu}{\sqrt{\frac{\sigma^2}{n}}} \sim Normal(0,1)$$

$$\mu = \boxed{\bar{X} \pm t_{\frac{\alpha}{2}}(n-1)\sqrt{\frac{S^2}{n}}} \quad 写要写\ t_{1-\frac{\alpha}{2}} \qquad \frac{\bar{X}-\mu}{\sqrt{\frac{S^2}{n}}} \sim t(n-1).$$

margin of error

confidence interval μ.