X: male college student height

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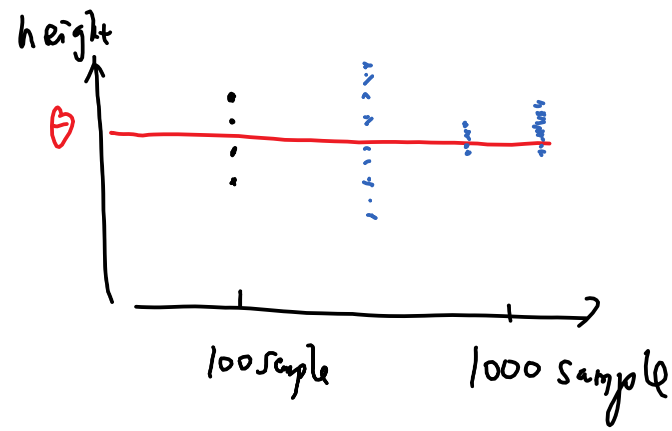
① → 100 sample $\bar{X}_1$ $\bar{X}$ → r.v.

② → 100 sample $\bar{X}_2$

⋮

$\bar{X}_i$



$z_{0.025} = 1.96$

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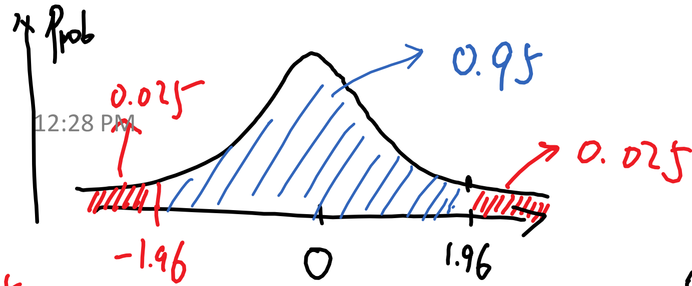
$P(Z>z_\alpha) = \alpha$

$p(Z>1.96) = 0.025$



$$\sqrt{n}\,\frac{\bar{X}-\theta}{S} \sim N(0,1)$$

$$P\left(-1.96 \le \sqrt{n}\,\frac{\bar{X}-\theta}{S} \le 1.96\right) = 0.95$$

$$\Rightarrow P\left(\bar{X} - \frac{1.96S}{\sqrt{n}} \le \theta \le \bar{X} + \frac{1.96S}{\sqrt{n}}\right) = 0.95$$

$$\frac{1.96S}{\sqrt{n}}$$

$$(\bar{X} \pm 1.96S/\sqrt{n}) \leftarrow 95\% \text{ CI}$$

99% CI:

$\alpha: 0.005 \quad z_\alpha = 2.58 \quad (\bar{X} \pm 2.58S/\sqrt{n})$

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$$G_X(z) = \sum_{k=0}^{\infty} (1-p)p^k z^k = \frac{1-p}{1-pz},$$

$$(1-p)\sum_{k=0}^{\infty}(pz)^k$$

$$\Downarrow$$

$$\frac{1}{1-pz}$$

$$e^{\lambda z} = \sum_{k=0}^{\infty} \frac{\alpha^k}{k!}$$

r.v. X

$$E[X] = \sum_{k=0}^{\infty} k \cdot p_k$$

$$E[X^2] = \sum_{k=0}^{\infty} k^2 \cdot p_k$$

r.v. $U = X + Y$

$P(X=i)$

$P(Y=j)$

$P(U=k)$?

$$\begin{aligned}P(U=k) = {} & P(X=0, Y=k) \\ & + P(X=1, Y=k-1) \to P(X=1)\cdot P(Y=k-1) \\ & + P(X=2, Y=k-2) \\ & \vdots \\ & + P(X=k, Y=0)\end{aligned}$$

$X \sim$ geometric

$Y \sim$ poisson distr.

$U = X + Y$ $\quad G_U(z)$

$G'\big|_{z=1} \to E[U]$

$$F_X^*(s) \equiv E[e^{-sX}] = \int_0^\infty f_X(x)e^{-sx}dx$$

$$E[X] = -\frac{d}{ds}F_X^*(s)\Big|_{s=0}$$

$$\frac{dF_X^*(s)}{ds} = \int_0^\infty -xe^{-sx}f_X(x)\,dx\Big|_{s=0} = \int_0^\infty -x\,f_X(x)\,dx$$

$$= -E[X]$$