$$\sigma = \frac{\sqrt{1-p}}{p} = \frac{\sqrt{\frac{1}{2}}}{\frac{1}{2}} = 1.414$$

$$X_{1}, \dots, X_{30} \overset{iid}{\sim} \text{Geome}\left(\tfrac{1}{2}\right) \Rightarrow \mu = \frac{1}{\frac{1}{2}} = 2$$

what is the prob. the avg wait time is more than 2.75?

$$P(\bar{X} \geq 2.75) = P\left(\frac{\bar{X}-2}{0.258} > \frac{2.75-2}{0.258}\right) = P(Z \geq 3) \approx \underset{\approx .0015}{\cancel{.0015}}$$

we know $n = 30$ is "large"

$$\bar{X} \overset{d}{\approx} N\left(\mu, \left(\frac{\sigma}{\sqrt{n}}\right)^2\right) = N\left(2, \left(\frac{1.414}{\sqrt{30}}\right)^2\right)$$

$$N = \left(2, (0.258)^2\right)$$

Take 100 steps with prof forward and Backward being $\frac{1}{2}$

$$X \overset{iid}{\sim} \begin{cases} +1 & wp\ \frac{1}{2} \\ -1 & wp\ \frac{1}{2} \end{cases} \Rightarrow \mu = 0,\ \sigma^2 = 1 \Rightarrow \sigma = 1$$

What is prob you ~~are~~ mor then 10 steps away from Starting point ~~after~~ after 100 steps.

$$X_1, \dots X_{199} \overset{iid}{\sim} \begin{cases} 1 & wp\ \frac{1}{2} \\ -1 & wp\ \frac{1}{2} \end{cases}$$

when x is larger $\lim_{x \to \infty} \frac{1}{x} = 0$ ie $\frac{1}{100,000} = \approx 0$

$$T = X_1 + \cdots + X_{100} \overset{d}{\approx} N(nm, (\sigma\sqrt{n})^2)$$

$$T = X_1 + \cdots + X_{100} \quad P(|T| > 10)$$

$$P(|T| > 10) = P(T > 10 \text{ or } T < -10)$$

$$= P(T > 10) + P(T < -10)$$

By CLT $T \sim N(nm, (\sigma\sqrt{n})^2)$

$$= N(100 \cdot 0, (1\sqrt{100})^2) = N(0, 10^2)$$

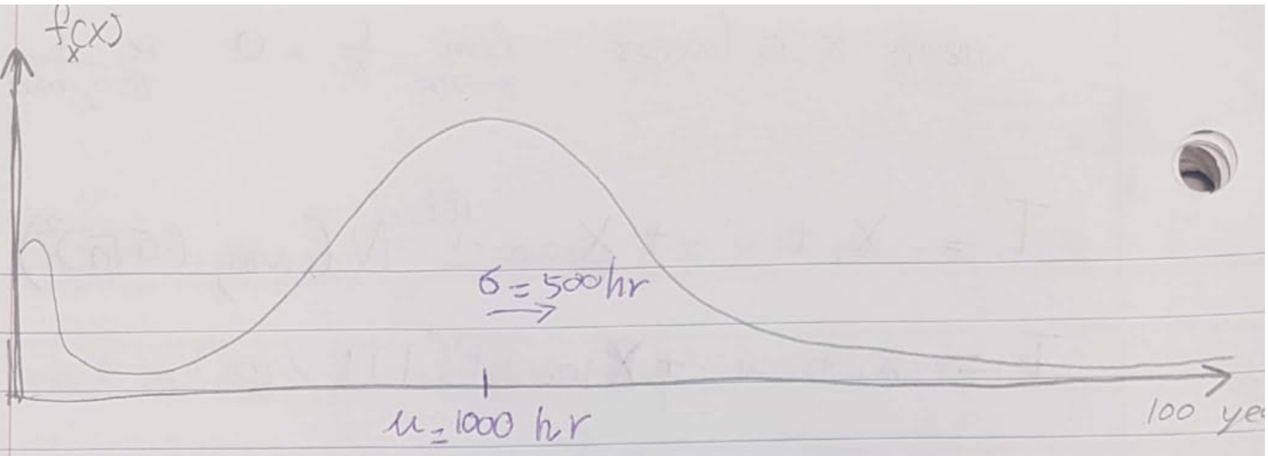
$$= P\left(\frac{T-0}{10} > \frac{10-0}{10}\right) + P\left(\frac{T-0}{10} < \frac{-10-0}{10}\right)$$

$$= P(Z > 1) + P(Z < -1)$$

$$= .16 + .16 = .32$$

Scanned by CamScanner

Problem #2



X is lifetime of a lightbolb

You get 50 light balbs. What is probability any lightbolt is more than 1300 hr.?

$P(\bar{X} > 1300)$: $\bar{X}$ is avg of 50 lightbolbs

By clt $\bar{X} \approx N\left(\mu, \left(\frac{\sigma}{\sqrt{n}}\right)^2\right)$

$= N\left(1000, \left(\frac{500}{\sqrt{50}}\right)^2\right) = N(1000, 70.7^2)$

$P(\bar{X} > 1300) = P\left(\frac{\bar{X} - 1000}{70.7} > \frac{1300 - 1000}{70.7}\right)$

$\simeq P(Z > 4.29) \simeq 0$

each one late 2% is $X_1, \dots X_{10,000} \overset{iid}{\sim} Burn(0.02)$

$\sigma = \sqrt{0.02(1-0.02)} = 0.14 \quad \mu = 0.02$

Shipments are ~~larte~~ late 2% of the time. What is prob in 10,000 shipment more than 3% are late?

$P(\bar{X} > 0.03)$

by clt $\bar{X} \approx N\left(\mu, \left(\frac{\sigma}{\sqrt{n}}\right)^2\right)$

$$\overset{t}{=} N\left(0.02, \left(\frac{0.14}{\sqrt{10,000}}\right)^2\right) = N(0.02, 0.0014^2)$$

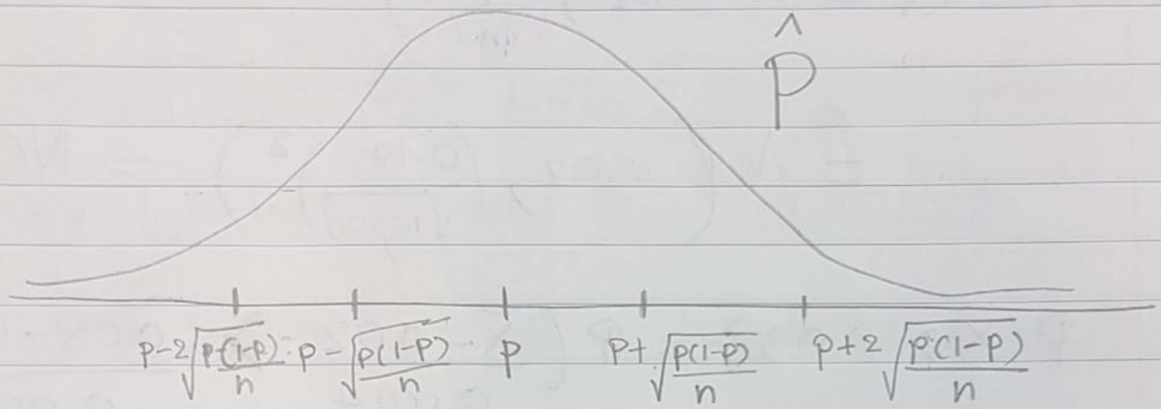
$$P(\bar{X} > 0.03) = P\left(\frac{\bar{X} - 0.02}{0.0014} > \frac{0.03 - 0.02}{0.0014}\right)$$

$$\simeq P(Z > 7.14) \approx 0$$

$\bar{X}$ is the r.v of the avg	$\hat{P}$ that's the r.v. of proportion
$\bar{x}$ is a realization (sample avg)	$\hat{p}$ "estimate" sample proportion
ie $\bar{x} = \frac{1+1+0+0+0}{5} = 0.4$	
$\bar{x} \in (0,1)$	

$\bar{X} \overset{d}{\approx} N\left(\mu, \left(\frac{\sigma}{\sqrt{n}}\right)^2\right)$

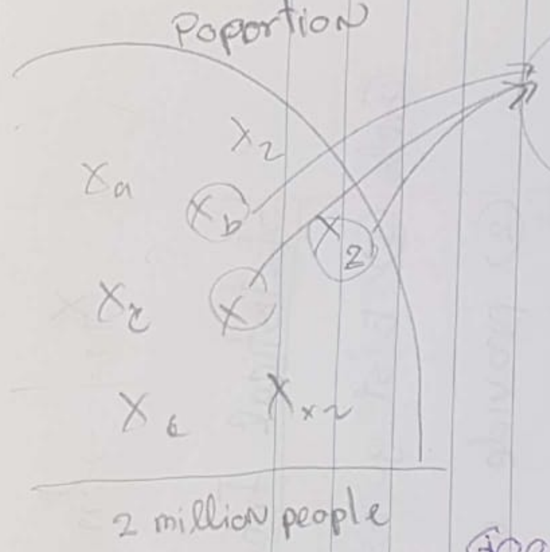
$\hat{P} \approx N\left(p, \left(\sqrt{\frac{p(1-p)}{n}}\right)^2\right)$



Statistial Inferance Goals:

1. Estimate p (best guss) Best guss $\hat{p}$
2. Create a range/window of likly value for p ie giveing rang 10 - 100 p is in that range
3. Test theory about p (Hypoteses testing)

sample < population

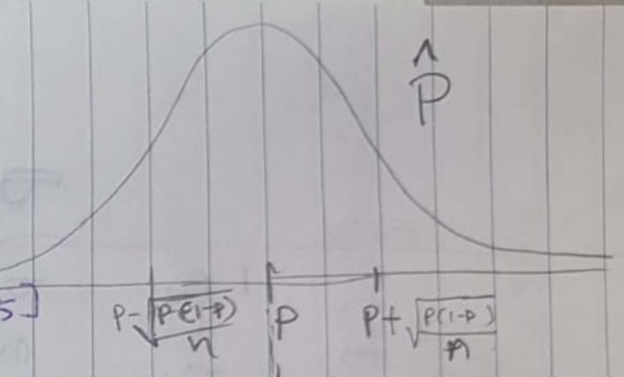


$n << N$

$\hat{p} = \frac{\sum X_i}{n}$ (best guess) $= [3 \pm 2] = [1, 5]$

"sample random otherwise.. bias!"

Goal (1)



Draw window

p in side window

What is th

$P\left(p \in \left[\hat{p} \pm \sqrt{\frac{p(1-p)}{n}}\right]\right) = P\left(\hat{p} - \sqrt{\frac{p(1-p)}{n}} \leq p \leq \hat{p} + \sqrt{\frac{p(1-p)}{n}}\right)$

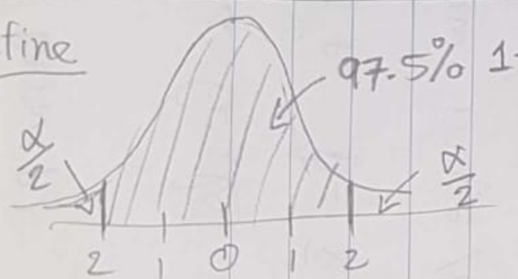
$= P\left(-\sqrt{\frac{p(1-p)}{n}} \leq p - \hat{p} \leq \sqrt{\frac{p(1-p)}{n}}\right)$

$- P\left(-1 \leq \frac{p - \hat{p}}{\sqrt{\frac{p(1-p)}{n}}}\right) = P(-1 \leq -Z \leq 1)$

$\approx Z$

$= P(1 \geq Z \geq -1) = P(Z \in [-1, 1]) = .68$

Define



$Z_{\frac{\alpha}{2}} : F_Z^{-1}\left(1 - \frac{\alpha}{2}\right)$

α 5% $\Rightarrow \frac{\alpha}{2} = 2.5\% \Rightarrow 1 - \frac{\alpha}{2} = 97.5\% \Rightarrow Z_{2.5\%} = 2$

$CI_{p, 1-\alpha} :=$

$\left[\hat{p} \pm \frac{2\alpha}{2} \sqrt{\frac{\hat{p}(1-\hat{p})}{n}}\right]$