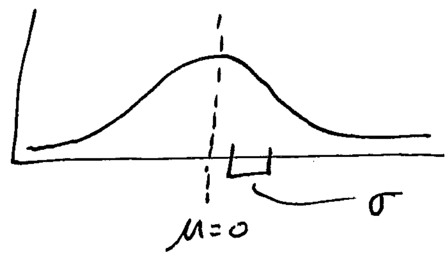
Review:

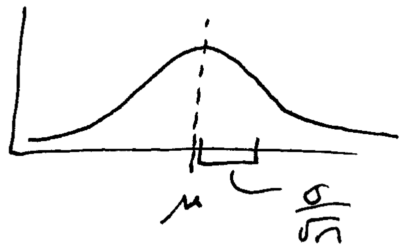
$Z \sim N(0,1)$

The "standard normal" distribution



$\bar{X} \sim N(\mu, \frac{\sigma^2}{n})$

The "sampling distribution"



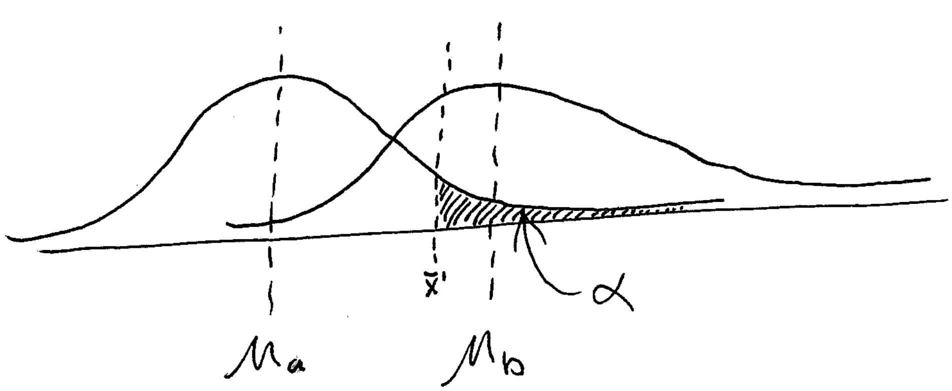
How to "normalize" the $\bar{X}$ distribution:

$$\boxed{Z = \frac{\bar{X} - \mu}{\sigma/\sqrt{n}}}$$

Calculate required sample size: (of a desired "power" level) (say 'a' is our control page:)

$H_0: \mu_a \geq \mu_b$ ← We'll assume our control is still the best.

$H_1: \mu_a < \mu_b$ ← The alternative is that our new page 'b' is better.



We will sample to obtain $\bar{X}_a, s_a, \bar{X}_b, s_b$.

To simplify, set $s = \frac{s_a + s_b}{2}$.

Under H_0, the α-cutoff is at $\bar{x}' = \mu_a + Z_{(1-\alpha)} \frac{s}{\sqrt{n}}$

Under H_1, the β-cutoff is at the same point

$$\bar{x}' = \mu_b + Z_\beta \frac{s}{\sqrt{n}}$$

Two equations, two unknowns ($\bar{x}'$ & n).

↳ solve for n.

by ~~setting~~ ridding $\bar{x}'$.

$$\mu_a + Z_{(1-\alpha)} \frac{s}{\sqrt{n}} > \mu_b + Z_\beta \frac{s}{\sqrt{n}}$$

⋮

Note:

$Z_\alpha + Z_{(1-\alpha)} = 1$

$$\boxed{n > \left(\left(Z_{(1-\beta)} - Z_\alpha \right) \frac{s}{\mu_b - \mu_a} \right)^2}$$