17. . . .

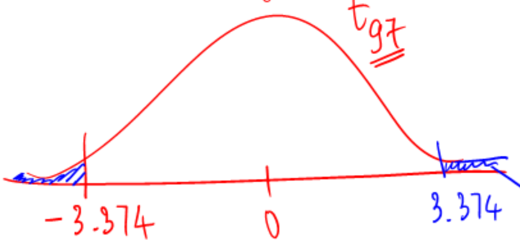
$H_0 : \mu = 20$ vs $H_1 : \mu < 20$.

$$T = \frac{\bar{X} - \mu_0}{s/\sqrt{n}} = \frac{\bar{X} - 20}{s/\sqrt{n}} \quad ; n = 98$$

$s, \bar{X} \to Q\,1(a)$

$= -3.374$

null distn of $T \sim t_{n-1} = t_{97}$



H_1 is left sided test

$\Rightarrow$ p-value is left area of T

$\to$ pt(3.374, 97, lower.tail = FALSE)

pt $\to$ t-distn

pnorm $\to$ normal distn

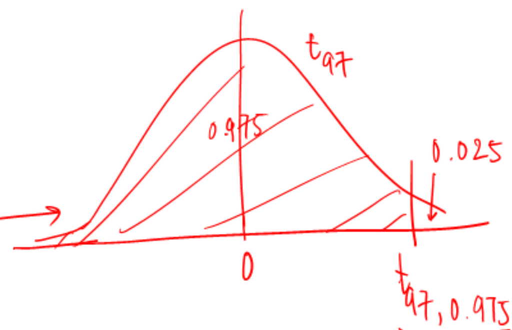
pf $\to$ F-distn.

CI for μ ; $\alpha = 0.05$

$$\bar{X} \pm t_{n-1;\,1-\frac{\alpha}{2}} * \frac{s}{\sqrt{n}}$$

mean(mark)

$\underbrace{t_{97;\,0.975}}$



quantile that left prob is 0.975

qt(0.975, 97)

Assumption of the test above:
- randomization ✓
- quant ✓
- [pop distn ~ normal.
  data distn ~ normal.
  if not normal then n large : ≥ 30.

$n = 98$.

From the hist & normal density curve $\to$ might not be normal.

But the sample size n = 98 $\to$ large enough $\to$ test result is still reliable.

$$T = \frac{\bar{X} - \mu_0}{s/\sqrt{n}} \xrightarrow{H_0 : \mu = \mu_0} \bar{X} \sim N(\mu_0 ; \sigma^2/n)$$

$$\Downarrow$$

$$\frac{\bar{X} - \mu_0}{\sigma/\sqrt{n}} \sim N(0,1)$$

$$\bar{X} \overset{CLT}{\underset{n \geq 30}{\sim}} N(\mu ; \sigma^2/\sqrt{n})$$

μ_0

$$\frac{\bar{X} - \mu_0}{s/\sqrt{n}} \sim t_{n-1}.$$

Normality test: H_0 : data comes from a normal distn.

H_1 : ______ a Non-normal distn.

→ p-value.

shapiro wilk test.

Q_2 : perform a test :
- assumptions
- state hypo : $H_0 : \mu_{diff} = 0$ vs $H_1 : \mu_{diff} < 0$
- test : $t = \ldots$ has null distn t_7
- p-value 0.048
- conclusion :