EC2020 live session 3 - class 3

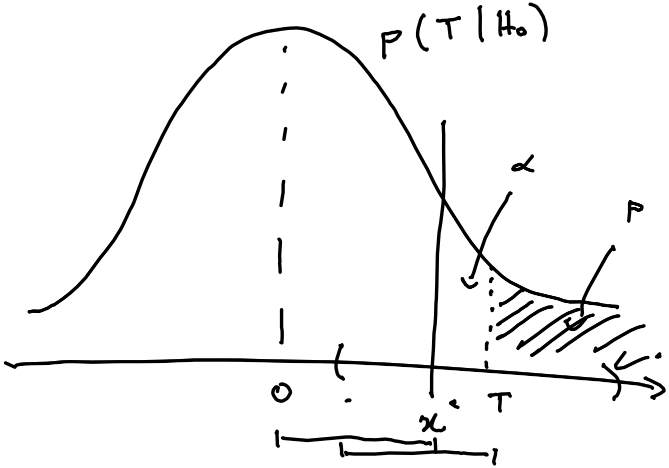
$$\log P_i = \alpha + \beta \log Area_i + \gamma AR_i + \varepsilon_i$$

$$\hat{\beta} : 1.33$$

$H_0 : \beta = 0$ vs. $H_1 : \beta \neq 0$

we have GM + normality

Assume H_0 is true



1. state hypotheses
2. state our assumptions
3. state test statistic (T)
4. give the distribution of T under H_0
5. calculate actual test statistic
6. p values; critical values; CI.

- $T > x_c$
- $p < \alpha$
- $0 \notin CI$

proof by contradiction. Assume A is true

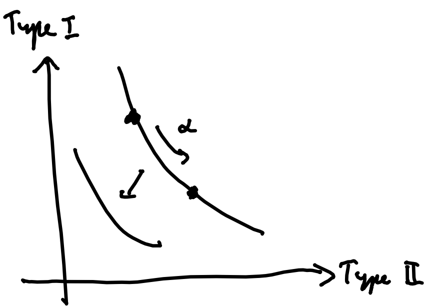
$A \Rightarrow B$

but B is false.

$\therefore$ A is false — contradiction

Analogy to hypothesis testing

$$T = \frac{\hat{\beta} - \beta}{\sqrt{\hat{v}}} \sim t_{n-3}$$



$$P\left(\overset{1.96}{-c_\alpha} \le T \le \overset{1.96}{c_\alpha}\right) = 0.95$$

$$P\left(-c_\alpha \le \frac{\hat{\beta} - \beta}{\sqrt{\hat{v}}} \le c_\alpha\right) = 0.95$$

$$P\left(\underbrace{\hat{\beta} - c_\alpha\sqrt{\hat{v}} \le \beta \le \hat{\beta} + c\sqrt{v}}_{\left[\hat{\beta} - c\sqrt{\hat{v}},\ \hat{\beta} + c\sqrt{\hat{v}}\right]}\right) = 0.95$$

$$\log P_i = \alpha + \beta \log Area_i + \gamma AR_i + \varepsilon_i \qquad \varepsilon_i \sim N(0, \sigma^2)$$

test if $\beta = 0$

$\rightarrow \cdot\ \hat{\beta} \sim N(\beta, V)$

$H_0: \beta = 0 \qquad H_1: \beta \neq 0$

$\rightarrow \cdot\ \dfrac{\hat{\beta} - \beta}{\sqrt{V}} \sim N(0,1)$

$$T = \frac{\hat{\beta} - \beta}{se(\hat{\beta})}$$

$\rightarrow \cdot\ \boxed{\dfrac{\hat{\beta} - \beta}{\sqrt{\hat{V}}}} \sim t_{n-3}$

Under $H_0: \beta = 0$

$$T = \frac{\hat{\beta} - \beta_0}{se(\hat{\beta})}$$

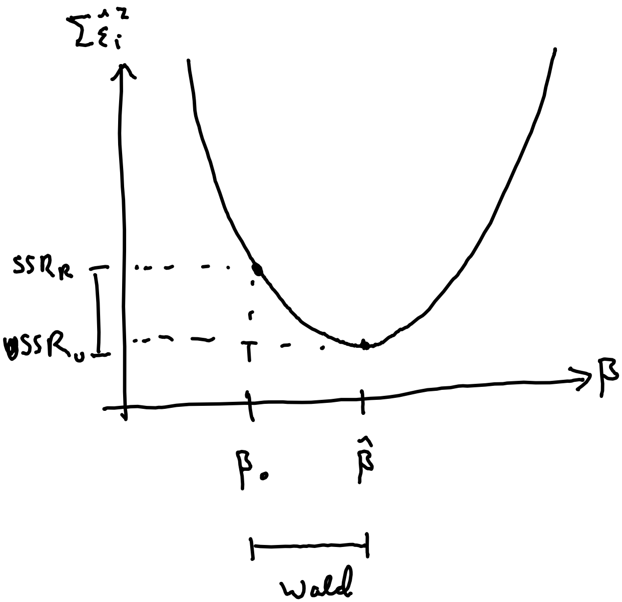
$$\frac{1.33}{0.09} = 14.66 > 2$$

$\sqrt{V}$ = standard deviation

$\sqrt{\hat{V}}$ = standard error

$$[\hat{\beta} - 1.96\, se,\ \hat{\beta} + 1.96\, se] = [1.16, 1.51]$$

~~$H_0: \beta = 0$ and $\gamma = 0$ H_1: not H_0~~



$$\hat{\beta} = \underset{b}{\text{argmin}} \sum \hat{\varepsilon}_i^2$$

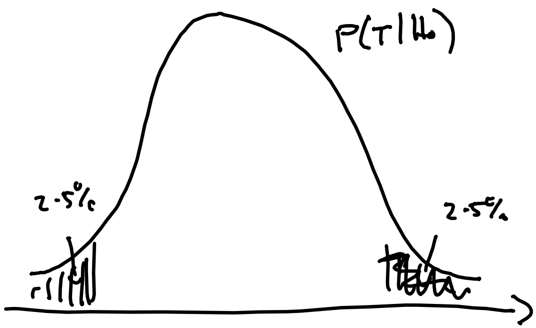
$H_0: \beta_0 = \beta_0$

$H_1: \beta \neq \beta_0$

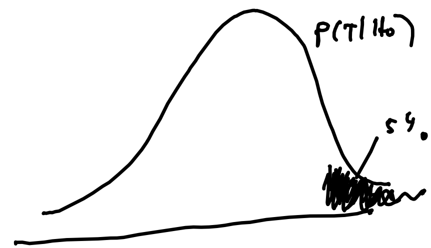
$$F = \frac{SSR_r - SSR_U / 2}{SSR_U / N-3} = \frac{R^2 / 2}{(1-R^2)/N-3}$$

$$\frac{x}{1-x}$$

$H_0: \beta = 1 \qquad H_1: \beta > 1$



at 95% two-sided



$H_0: \beta_{bed} = \beta_{bath} \qquad H_1: \beta_{bed} \neq \beta_{bath}$

$\iff$

$H_0: \beta_{bed} - \beta_{bath} = 0$

$$\hat{\beta}_{bed} \sim N(\beta_{bed}, V_{bed})$$

$$\hat{\beta}_{bath} \sim N(\beta_{bath}, V_{bath})$$

$$\hat{\gamma} = \hat{\beta}_{bed} - \hat{\beta}_{bath} \sim N\Big(\beta_{bed} - \beta_{bath},\ \underbrace{V_{bed} + V_{bath} - 2\,\mathrm{cov}}_{\tilde{V}}\Big)$$

$H_0: \hat{\gamma} = 0$

$$\frac{\hat{\beta}_{bed} - \hat{\beta}_{bath} - (\beta_{bed} - \beta_{bath})}{\sqrt{\hat{V}}} \sim t_{n-5}$$