EC2020 Session 3

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$y_i = \alpha + \beta x_i + \varepsilon_i$

$H_0: \beta = 0 \longrightarrow$ didn't work $H_0: \beta = 0$

$H_1: \beta \neq 0 \longrightarrow$ did work $H_1: \beta > 0$

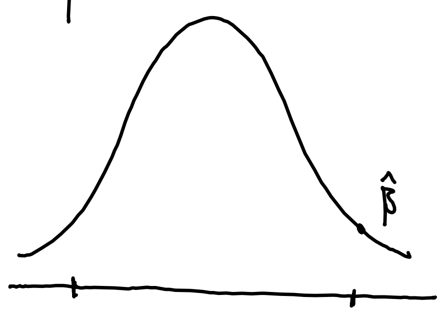
$\boxed{\text{(i) what do the hypotheses \underline{really} mean}}$

$\boxed{\hat{\beta} \simeq 0}$ then want to conclude H_0 is prob. true

if not $\rightarrow$ false

$$\hat{\beta} = \frac{\widehat{cov}(x_i, y_i)}{\widehat{var}(x_i)}$$

$\hat{\beta}$ has a distribution



$$\boxed{y_i = \alpha + \beta x_i + \varepsilon_i \qquad \varepsilon_i \sim N(0, \sigma^2)}$$

$$\hat{\beta} \sim N(\beta, V) \qquad \frac{\sigma^2}{\sum (x_i - \bar{x})^2} = V$$

$$\hat{V} = \frac{s^2}{\sum (x_i - \bar{x})^2}$$

- Assume $\beta = 0$
- work out $P(\hat{\beta} >$ what we see$)$
- if low $\Rightarrow$ reject that $\beta = 0$

Under H_0

[if $\beta = 0$]

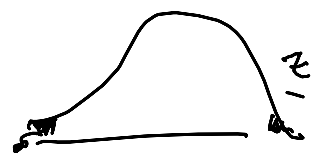
$$\hat{\beta} \sim N(0, V) \Rightarrow \frac{\hat{\beta}}{\sqrt{V}} \sim N(0,1)$$

$$Z = \frac{\hat{\beta}}{\sqrt{\hat{V}}} = \frac{\hat{\beta}}{se(\hat{\beta})} \sim N(0,1)$$

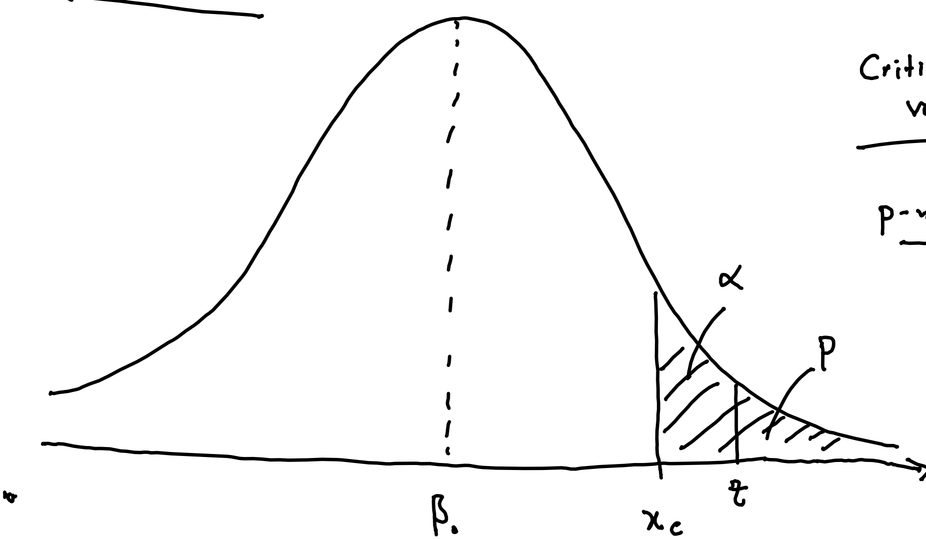
- Assume H_0 is true
- Under H_0 some test statistic has known distribution

Under H_0 $\quad Z = \dfrac{\hat{\beta}}{se(\hat{\beta})} \sim N(0,1)$

- calculate Z
- if Z is in tails $\Rightarrow$ reject H_0



Confidence Interval: set of numbers for which don't reject H_0 $\quad \boxed{z \in CI}$



Critical value: reject if $\boxed{z > x_c}$

p-value: $z > x_c \iff p < \alpha$

reject if $\boxed{p < \alpha}$

Prob($Z > z$ under H_0)

Q1

1.33

$$\underline{\log Price_i} = \underline{\alpha} + \underline{\beta}\, \underline{\log Area_i} + \underline{\gamma}\, AR_i + \varepsilon_i$$

"Interpret the parameters"

price Area

$$y_i = \alpha + \beta x_i + \varepsilon_i$$

$$E(y_i|x_i) = \alpha + \beta x_i$$

$$\beta = \frac{\partial E(y_i|x_i)}{\partial x_i}$$

$$\beta = \frac{\%\Delta\, price}{\%\Delta\, area}$$

if Area 1 p.p. higher

we would expect

price 1.33 p.p. higher

"significance" of β / statistical significance

we can reject the hypothesis that $\boxed{\begin{array}{l} H_0: \beta = 0 \\ H_1: \beta \neq 0 \end{array}}$ (1)

(1) hypotheses

(2) what assumptions

(3) Give T.S. and distribution under H_0

(4) calculate T.S.

(2) Normal errors

$$\rightarrow \quad Z = \frac{\hat{\beta}}{\sqrt{V(\hat{\beta})}} \sim N(0,1) \quad \text{under } H_0: \beta = 0$$

$\boxed{t_n \approx N(0,1) \text{ if } n \text{ large}}$

(3) $$T = \frac{\hat{\beta}}{se(\hat{\beta})} \sim t_{n-3} \quad \text{under } H_0$$

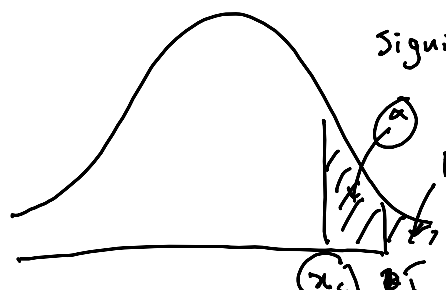
(4) $$T = \frac{1.334}{0.091} \approx 14.66$$

(5) Pick a cutoff

(α = 1%, 5%, 10%, ...)

(6) Look up x_c from α

Significance level $\alpha = 10\%$



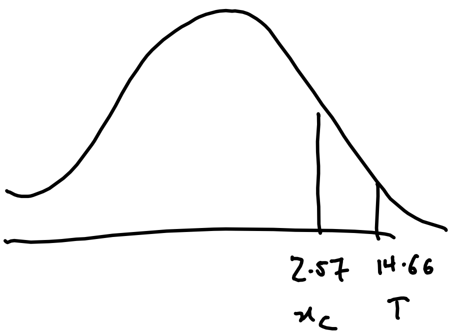
(7) reject if $T > x_c$ otherwise don't reject □

$T = 14.66$

$\alpha = 1\%$ $\qquad x_c = 2.57$

$H_0: \beta = 0$

$H_1: \beta \neq 0$



$\therefore$ reject H_0

$\rightarrow$ β <u>is</u> statistically significant

$$y_i = \alpha + \underline{\overbrace{1000000}^{\hat{\beta}}}\, x_i + \varepsilon_i$$