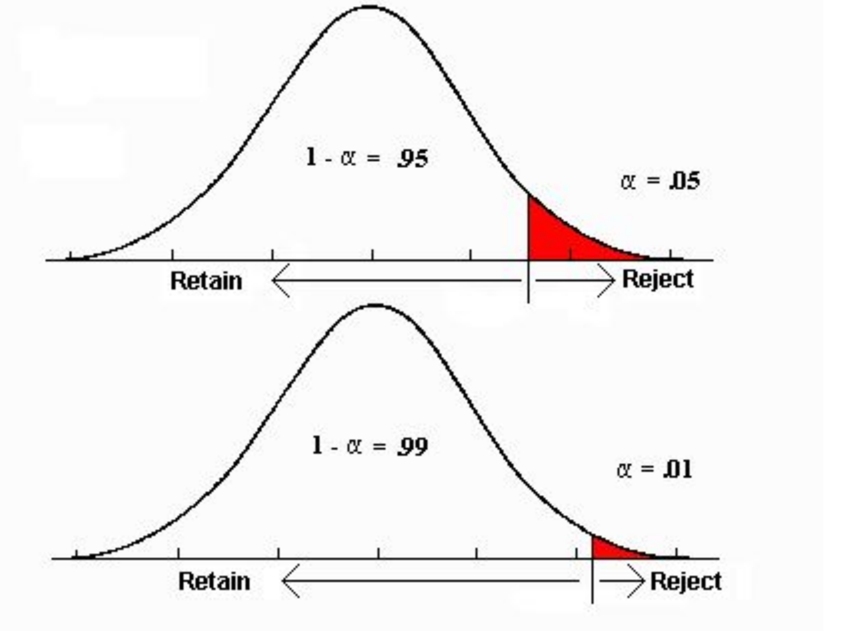
Ch 21: More about Tests

AP Statistics – almost done with Unit 5 (Ch 18 to Ch 22)

Thinking about P Value

- P-value is a conditional probability
  - P of getting results given H0 is true
  - P(observed stat value or more extreme | H0)
  - ALWAYS start with the Null Model!
  - NOT:
    - P that H0 is true
    - P (H0 is true | observed statistic value)

Alpha Levels



- Small p-value?

Data seen are rare given the H0.

- Rare enough?
- Alpha Level (α) = Significance Level: Threshold for P-value; if P-value is below it, we'll <u>reject H0</u> and say results are <u>statistically significant</u>.
- Common alphas: 0.1, 0.05, 0.01 (e.g. "at the 0.1 level of significance")
- Directly related to choice in CI. 90% CI means α = 0.05
- Pick an appropriate one for your study <u>before</u> collecting data

Checklist for a One-Proportion Z-Test

- State H0 and Ha
- Check conditions
- State you are using a One-Proportion Z-Test
- State alpha
- Write and draw your null model
- Calculate z, P-value
- Conclude
  - State assumption (H0, null model)
  - Use P-value
  - Use alpha and “statistically significant”
  - State reject or fail to reject H0
  - Add CI based on H0 (if it helps add evidence) (state % interval, show z* or mention 68/95/99.7 rule with 1/2/3 SD)– does value fall within or outside the interval, and what does this indicate?

Practice: CI, alpha, conclusion re. H0

- A bank used ads compelling customers to set up payment plans, to avoid late fees. A 90% CI for the success rate is (0.29, 0.45). A prior method worked 30% of the time. Can you reject H0: p = 30% at alpha = 0.05? Draw a picture using the above information. You should not need to do any calculation to arrive at a conclusion.

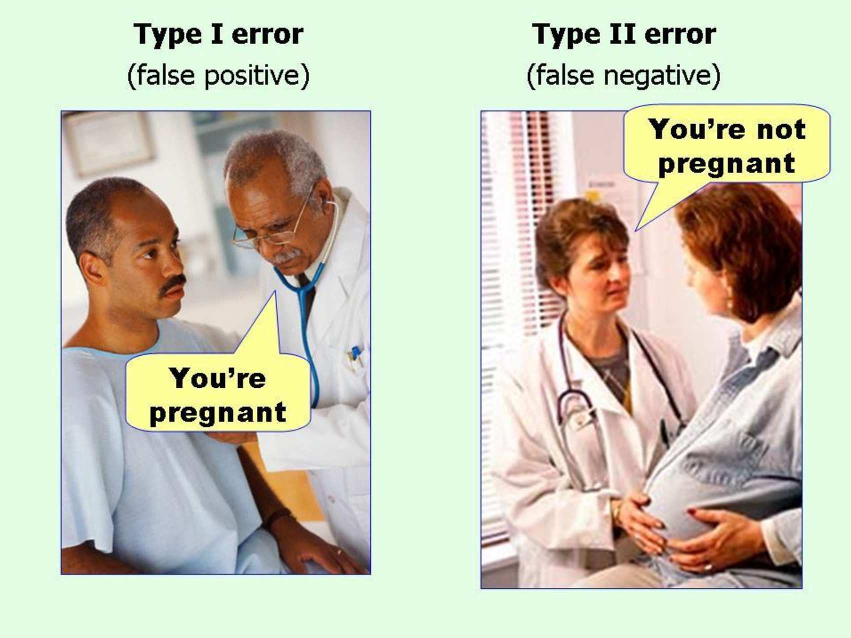
Type I and II Errors

- Recall we assume H0 is true, then calculate P-value and make a conclusion.
- We can make errors!

- Type I: H0 is <u>true</u>, but we mistakenly reject it.
  - False positive
- Type II: H0 is false, but we fail to reject it.
  - False negative

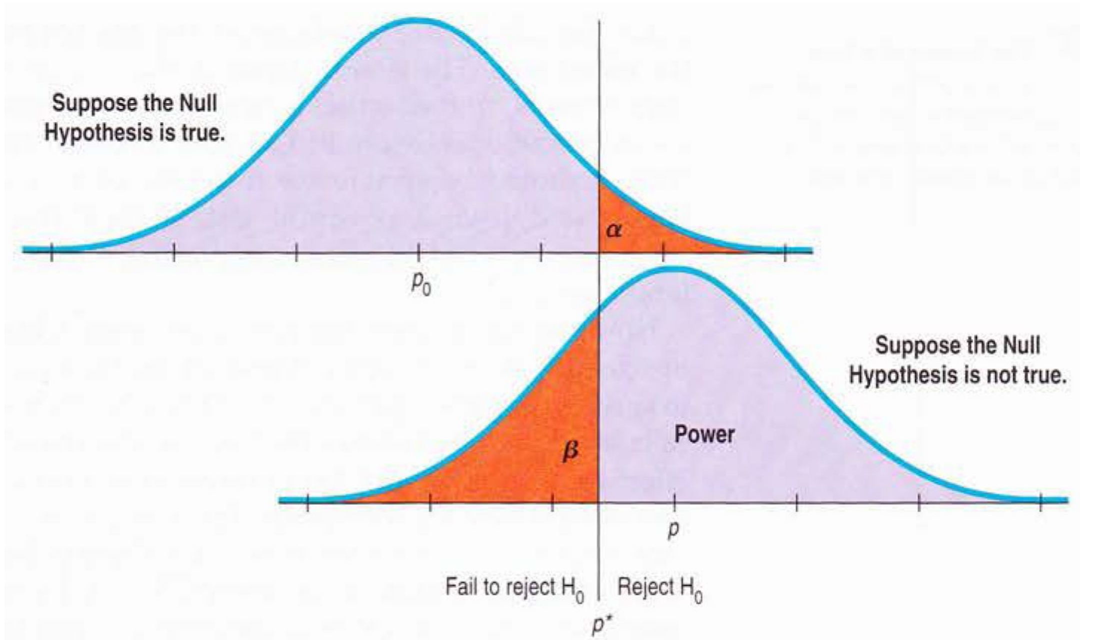
		Reality: True	Reality: False
Measured/Perceived	True	Correct ☺	Type I False Positive
	False	Type II False Negative	Correct ☺

- P of a Type I error = α← we already knov this
- P of a Type II error = β ← Ha is too broad to give us β; β is your chance to give a specific effect you would like to se (e.g. a minimum cutoff)



Power

- Test's ability (P) to detect a false H0 = <u>power</u> of the test
  - This uses a "True Model" that is not the Null Model.
  - Ideally P is high
  - Power of test = 1 – β



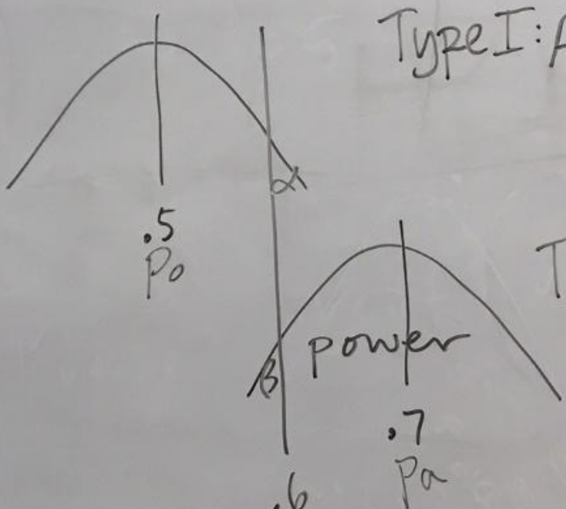
Note: To calc Power, assume H0 is calculate P-value.)

How far is truth from H0? Distance btwn p0 and truth (p) = **<u>effect size</u>**
Want more power? Increase one of these:
Increase n, effect size, alpha

Power Example

The bank wants to spend more money on a new marketing strategy to get customers to make payments on time. It would like to see that this more expensive strategy produces a higher success rate than its 30% rate from before.

- What is a Type I error in this context, and what would be the consequences to the bank?
- What is a Type II error , and what would be the consequences to the bank?
- If the new strategy works, getting 60% of customers to pay on time, would the power of the test be higher or lower compared to a 32% pay off rate?

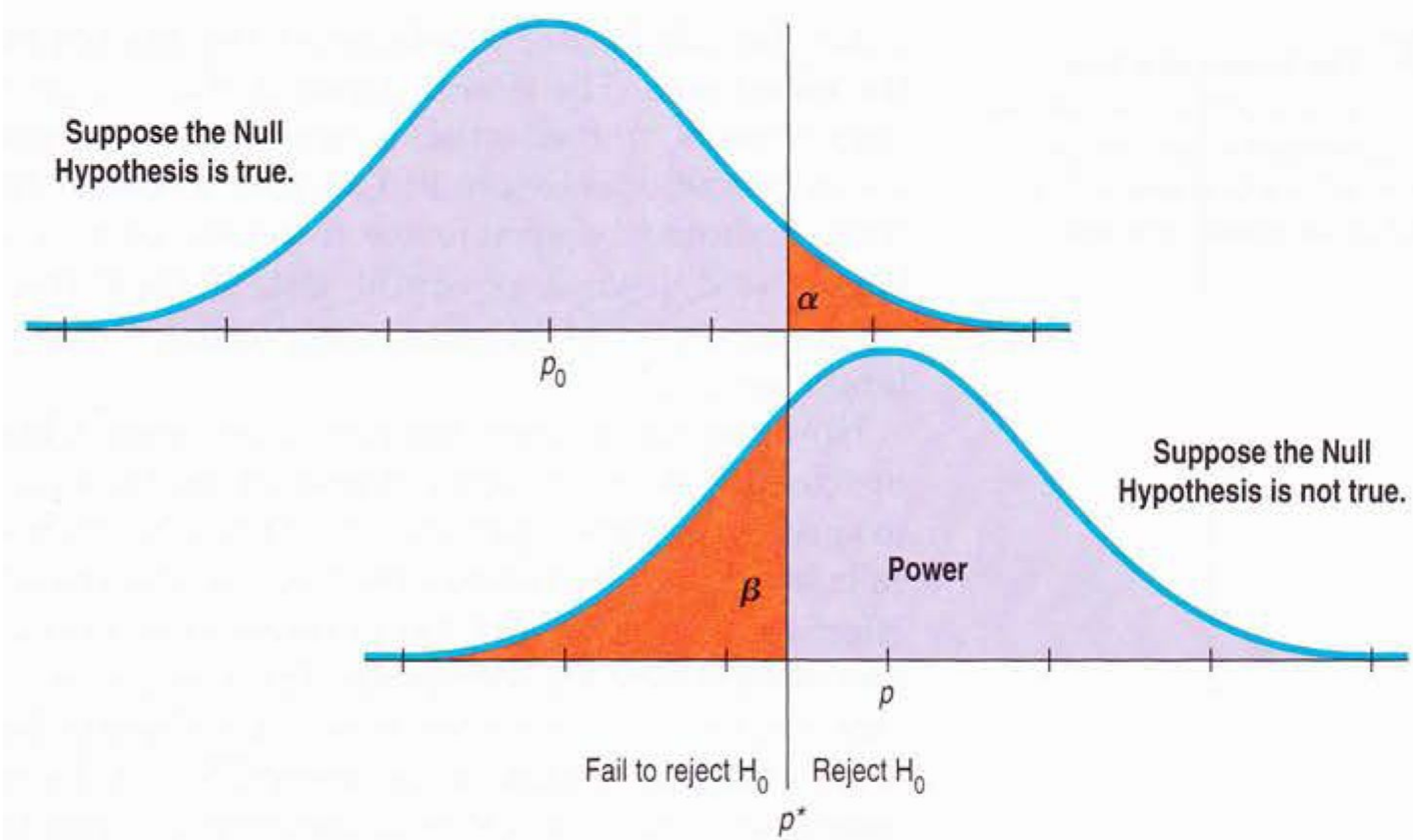


Type I: Assuming true $\mu_p = .5$,

$\bar{x}_p$ is .7 and I <u>reject</u> H_0.

Type II: Assume true $\mu_p = .7$,

$\bar{x}_p$ is .5 and I <u>fail to reject</u> H_0



- If α increases, what happens to β? Power?
- What if α decreases?
- What if the true model's p increases? What happens to α, β, power?
- Define p* using "critical value" in your sentence. Does it change when β, power, or the true model's p changes?

Checklist for a One-Proportion Z-Test, More Thoroughly Presented

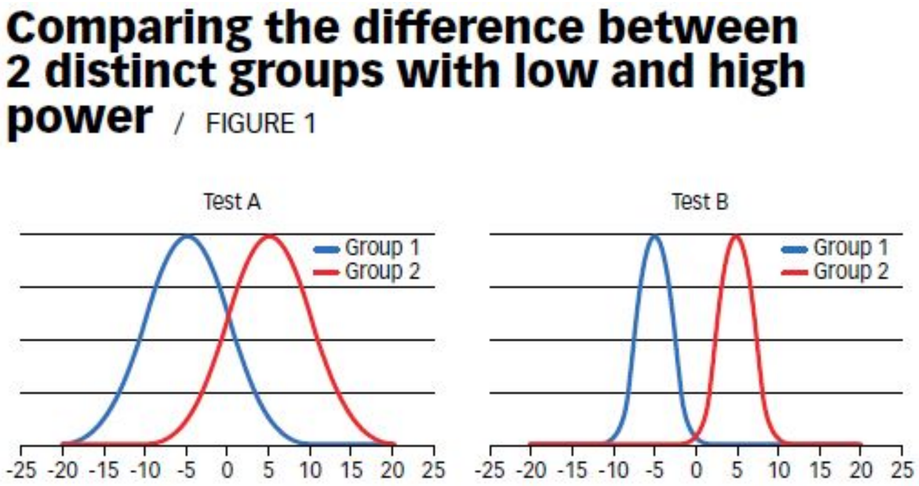
- State H0 and Ha
- Check conditions
- State you are using a One-Proportion Z-Test
- State alpha
- Write and draw your null model
- Calculate z, P-value
- Conclude
  - State assumption (H0, Null model)
  - Use P-value
  - Use alpha and "statistically significant" and "type I" with a description
  - State reject or fail to reject H0
  - Add CI based on H0 (if it helps add evidence) (state % interval, show z* or mention 68/95/99.7 rule with 1/2/3 SD)– does value fall within or outside the interval, and what does this indicate?
  - Describe p for an assumed true model, beta (and "type II" with a description), power of the test.

Reducing both Type I and Type II Error

- Type I and Type II Error Ps can never be zero.
- Narrower variation decreases both errors.

What is parameter of variation for our models?

How do we decrease it?



Beware: Diminishing returns applies

_____ of a sampling dist. decreases as the square root of _____.