COGS2020

WEEK 7: INFERENCE ERRORS AND EFFECT SIZE

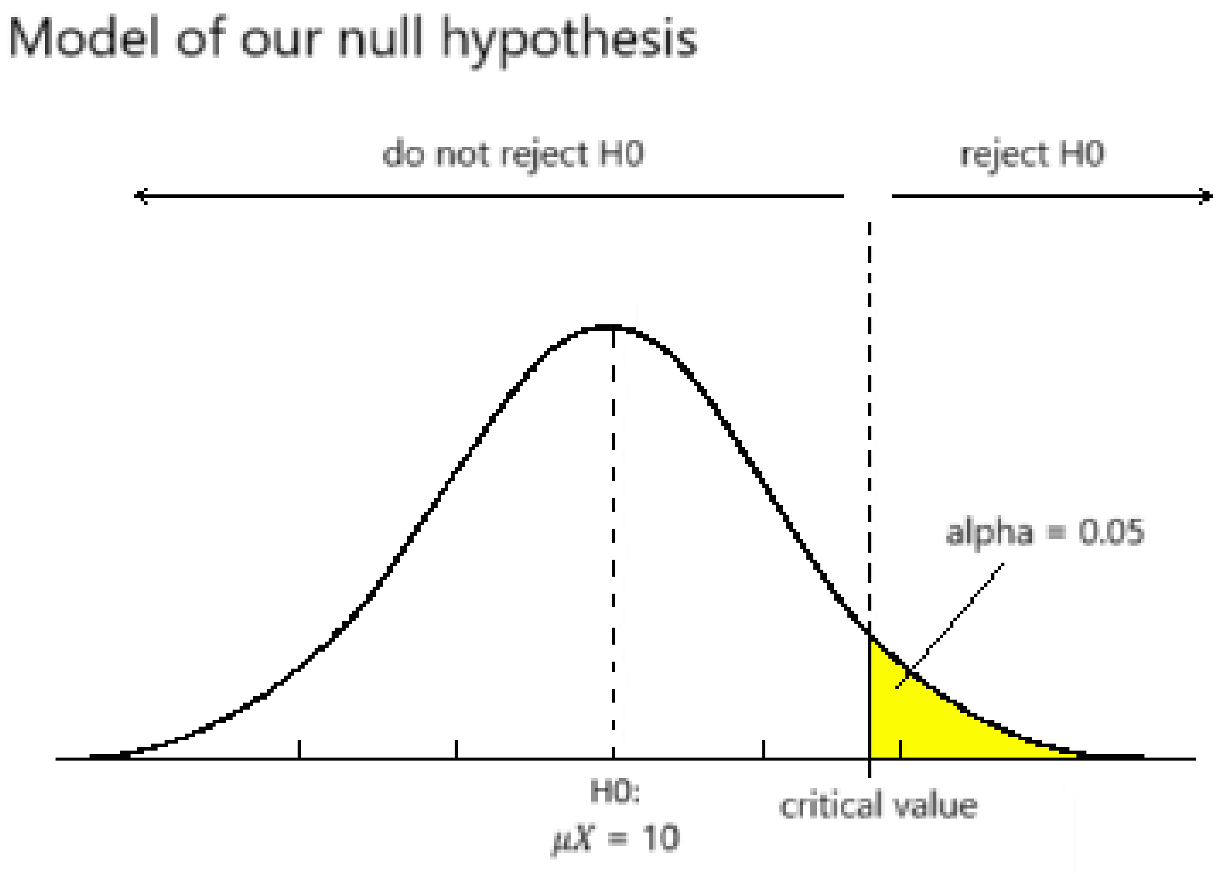
Recap (from last week)

- **Null Universe**: The neuron is not stimulus-driven. The **Expected Value** of X is 10 spikes per second.
- **Alternative Universe**: The neuron is stimulus-driven.
- We want to know which universe we are in.
- We write this as:

$$H0\text{: } \mu X = 10$$

$$\text{H1: } \mu X > 10$$

Recap pt. 2 (from last week)



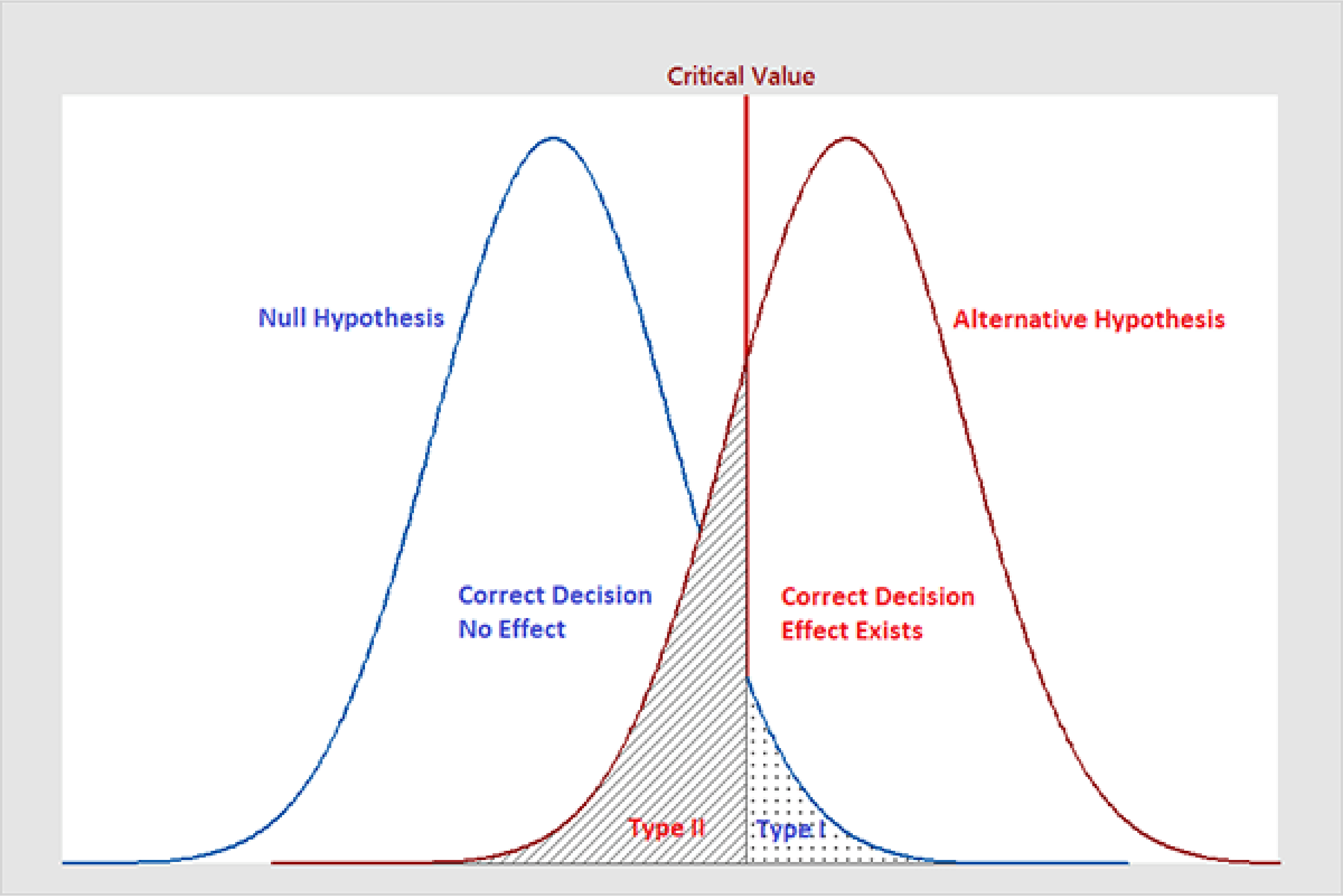
- **Alpha** = rejection zone, extreme 5%, values that fall here are deemed unlikely given this null distribution
- **Critical value** – the cutoff value that defines our rejection zone

Decision Matrix

Decision	$H0$ **True**	$H0$ **False**
Fail to reject $H0$	Correct Decision (*confidence*) **True negative*	Type II Error (β) **Not rejecting H0 when you should have*
Reject $H0$	Type I Error (α) **Rejecting H0 when you shouldn't have*	Correct Decision (*power*) **True positive*

Power (1 - beta)

- Power is the probability of rejecting $H0$ when $H0$ is false.
- It is the probability of finding an effect when there is really an effect there to be found.
- Power > 0.8
- Power increases as sample size increases.
- This is because the standard error of the mean decreases as sample size increases.


Critical Value
Null Hypothesis
Alternative Hypothesis
Correct Decision
No Effect
Correct Decision
Effect Exists
Type II
Type I

Effect Size

- In a **single-sample test**, we ask whether the **true population mean** of a variable is meaningfully different from a hypothesized value (e.g., CC).
  - $H0$: μX = C
  - $H1$: μX < C
- The **effect size** quantifies the magnitude of that difference, using a standardized metric.
- This helps us assess whether a result is not just statistically significant, but also **meaningful** in practical terms.

Cohen’s D

- Cohen’s *d* is a widely used measure of effect size.
- For a **single-sample test** (with known population standard deviation), it is:

$$d = \bar{x} - \mu 0 \ / \ \sigma$$

- This tells us how far the sample mean is from the hypothesized mean, in standard deviation units.
- For example, if $\bar{x}$ = 1, $\mu 0$ = 0, and σ = 1, then d=1.0.

P hacking

- Large n makes any difference significant.
- If you perform many statistical tests, the chance of a false positive increases (multiple comparisons).