4. A study was conducted of 90 adult male patients following a new treatment for congestive heart failure, and the increase in exercise capacity (in minutes) over a four-week treatment period. The data yields the mean increase 2.17 minutes, and the sample standard deviation 1.05 minutes. Researchers wants to evaluate whether the new treatment had improved the exercise capacity in comparison to the standard treatment which has produced an average increase of 2 minutes.

(a) Construct the null and alternative hypothesis for the test.

Claim: $\mu > 2$

μ = true population mean of the increase

the opposite

$\boxed{H_0: \mu \leq 2}$ $\xrightarrow[\text{Reject } H_0]{}$ $\boxed{H_A: \mu > 2}$

Null hypothesis

Alternative hypothesis

The null hypothesis is that the true mean is less than or equal to 2 minutes. The alternative hypothesis is that it is more than 2 minutes.

(b) Calculate the test statistic. Using the significance level 0.05, find the critical region for the test.

(c) What conclusions can you draw from this study?

(b) Test statistic T = 1.535963

Critical region: $T > 1.662155$

(c) Since $T = 1.536 < 1.662$, we cannot reject Ho. There is not sufficient evidence to support the claim.

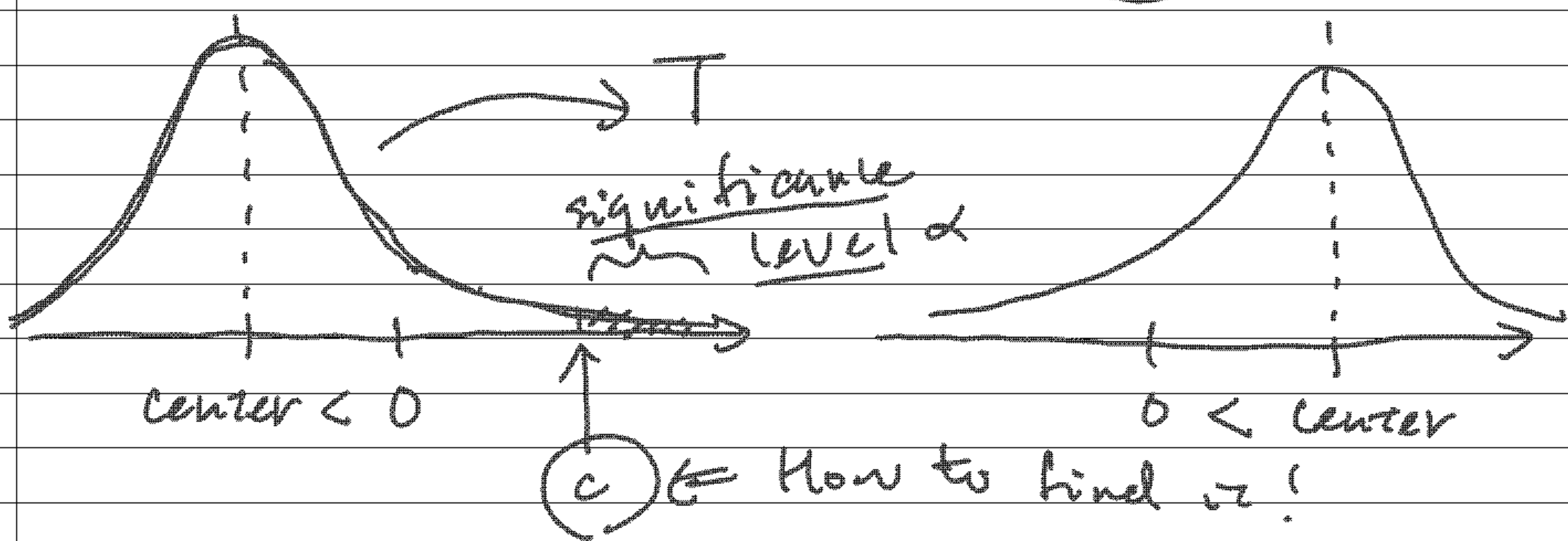
Test statistic and critical region

Test statistic

$$T = \frac{\overline{X} - 2.0}{S/\sqrt{n}}$$ ⇐ the null value μ_0

the claim is true ⇓

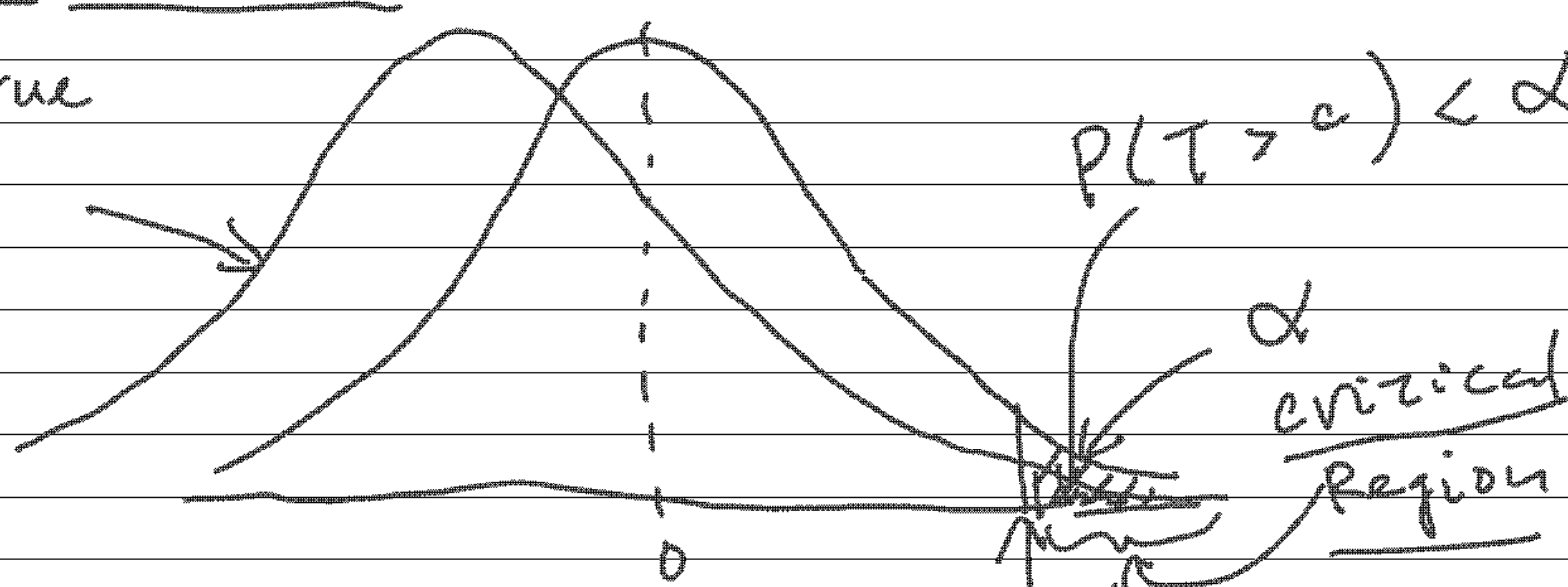
① If $H_0\ (\mu \le 2.0)$ is true ② If H_0 is false



If $T > c$ then we reject H_0

t-distribution

H_0 is true



$c = \begin{bmatrix} \text{critical point} \\ \text{with level } \alpha \end{bmatrix}$

α = significance level

= the probability that H_0 is rejected incorrectly.

= the probability of type I error.