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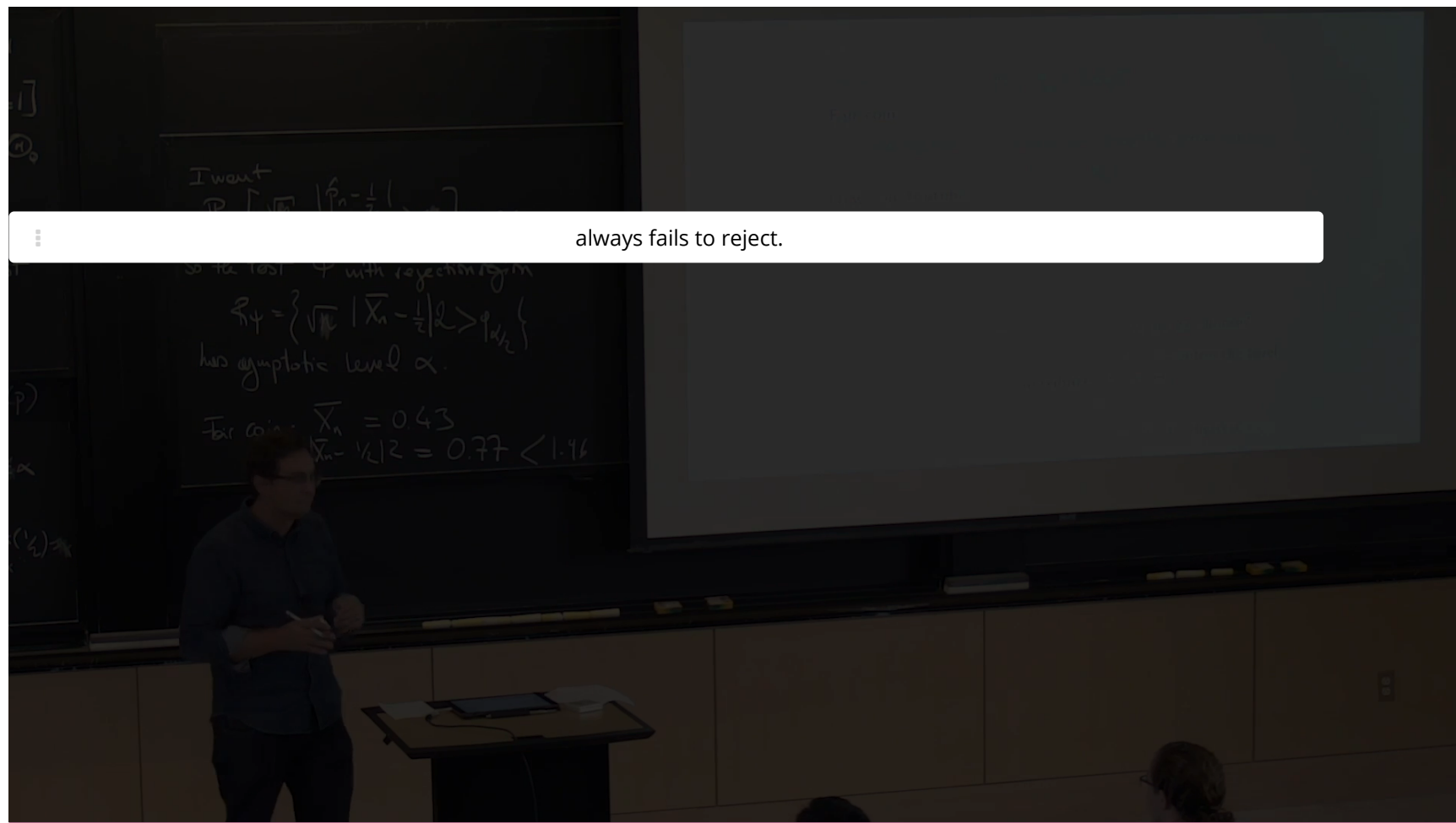


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4. Worked Example: Conclusion of a Two-Sided Test

Conclusion and Comments on the Two-Sided Test for a Bernoulli Experiment



4:30 / 4:30

1.50x

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Rejecting or Failing to Reject the Null Hypothesis I

2/2 points (graded)

In this problem, we will complete the hypothesis testing procedure for testing if a coin is fair.

Setup as before:

You observe $X_1, \dots, X_n \stackrel{i.i.d.}{\sim} \text{Ber}(p^*)$ (each X_i models a coin flip) and want to decide if $p^* = 1/2$. The associated statistical model is $(\{0, 1\}, \{\text{Ber}(p)\}_{p \in (0,1)})$ and the null and alternative hypotheses are

- $H_0 : p^* = 1/2$
- $H_1 : p^* \neq 1/2$.

You design the statistical test:

$$\psi_n = \mathbf{1}(T_n > q_{\alpha/2})$$

where $T_n = \sqrt{n} \frac{|\bar{X}_n - 0.5|}{\sqrt{0.5(1-0.5)}}$

where $q_{\alpha/2}$ denotes the $1 - \alpha/2$ quantile of a standard Gaussian, and α is determined by the required level of ψ . Note the absolute value in T_n for this two sided test.

Questions:

You flip the coin 200 times and observed 80 Heads. Recall from the problem *Hypothesis Testing: A Sample Data Set of Coin Flips I* in the previous lecture that the value of the test statistics T_n for this data set is $T_{200} = 2.83$.

If the test $\psi = \mathbf{1}(T_n > q_{\alpha/2})$ is designed to have asymptotic level 5%, would you **reject** or **fail to reject** the null hypothesis $H_0 : p^* = 1/2$ for this data set?

☒ Reject

☐ Fail to reject



If instead, the test $\psi = \mathbf{1}(T_n > q_{\alpha/2})$ is designed to have asymptotic level 10%, would you reject or fail to reject H_0 using the same data set?

☒ Reject☐ Fail to reject**Solution:**

- If ψ is designed to have asymptotic level 5%, this implies that $\alpha = 0.025$, according to the problem on the problem. By using a table or computational tools, we see that $q_{0.025} = 1.96$.

In the problem "Hypothesis Testing: A Sample Data Set of Coin Flips I", we computed that $T_{200} = |-2.82842| \sim 2.83$. Since $T_{200} = |-2.82842| > 1.96$, we have $\psi = 1$ and we **reject** the null.

- If instead ψ has asymptotic level η where $\eta > \alpha$, then $q_{\eta/2} < q_{\alpha/2}$, i.e. the threshold decreases, leading to $T_{200} > q_{\eta/2}$. Therefore, we again reject H_0 .

Remark: A test with a smaller (asymptotic) level is more "stringent" than a test of the same form with a greater (asymptotic) level.

You have used 1 of 1 attempt

i Answers are displayed within the problem

Discussion

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