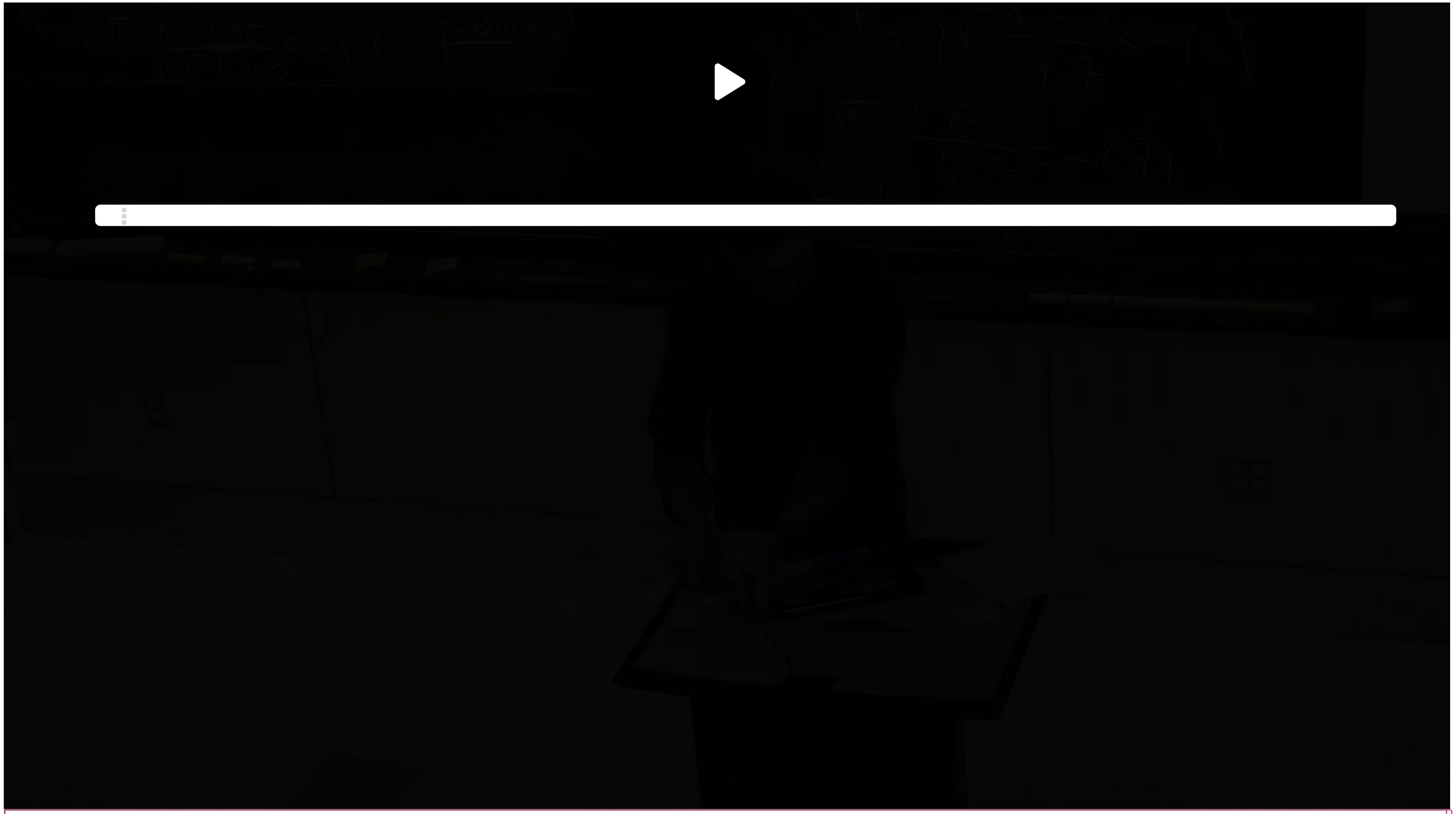
# 10. Is the False Positives Rate Below 95 Percent?

# Worked Example 3: Verifying the Effectiveness of New Machine Learning Algorithm

Generating Speech Output



11:34 / 11:34

1.50x

### Video

[Download video file]

### Transcripts

[Download SubRip (.srt) file]

[Download Text (.txt) file]

---

## Visualizing the p-value

Generating Speech Output

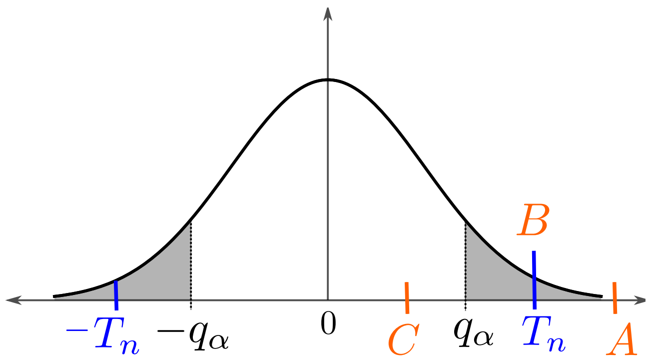
4/4 points (graded)

Suppose we have a test statistic $T_n$ such that $T_n \sim |Z|$ where $Z \sim N(0,1)$. In particular, for this problem we know the distribution of $T_n$ for any fixed $n$ and not just asymptotically. You design the test

$$\psi_n = \mathbf{1}\left(T_n \geq q_{\eta/2}\right)$$

where $q_\eta$ is the $1-\eta$ quantile of a standard Gaussian (*i.e.*, if $Z \sim N(0,1)$, then $P(Z > q_\eta) = \eta$). If $\psi = 1$, we will reject $H_0$, and if $\psi = 0$, we will fail to reject $H_0$.

With this set-up, you observe a data set and compute $T_n$. Consider the following figure:




On which side, **to the left** or **to the right**, of $T_n$ should the value $q_{\eta/2}$ be such that $\psi_n$ rejects on our data set?

To the left of Tn. ▼ ✔ **Answer:** To the left of $T_n$.

What is the largest value of $q_{\eta/2}$ such that $\psi_n$ rejects on our data set?

B ▼ ✔ **Answer:** B

What is the smallest value of $\eta$ so that $\psi_n$ rejects on our data set? (Note that this is the p-value for our data set.)

Generating Speech Output

- ○ $\eta = 2 \times (\text{the area under the curve to the right of A})$
- ◉ $\eta = 2 \times (\text{the area under the curve to the right of B})$
- ○ $\eta = 2 \times (\text{the area under the curve to the right of C})$

✔

Now you observe a new data set and compute a new value of the test statistic, which we denote by $T_n'$. Suppose that $T_n' < T_n$, *i.e.*, the test statistic has a smaller value than from before.

Will the new p-value be **larger** or **smaller** than the p-value from the previous data set considered in this problem?

- ◉ Larger
- ○ Smaller

✔

**Solution:**

For the first question, if $q_{\eta/2}$ is to the left of $T_n$ (*i.e.*, $q_{\eta/2} < T_n$), then we see that $\psi = \mathbf{1}\left(T_n \geq q_{\eta/2}\right) = 1$. Hence, we would reject in this situation. For the second question, we know that $\psi$ rejects if $q_{\eta/2}$ is to the left of $T_n$. Hence, we should make $q_{\eta/2}$ as large as possible so that we still reject. This implies we set $q_{\eta/2} = T_n$, and the correct choice is B. For the third question, note that $\eta/2$ is the area under the curve to the right of $q_{\eta/2}$. Based on the last question, the correct response is "$\eta = 2^* \,(\text{the area under the curve to the right of B})$". Note that this is the p-value for our data set. For the final question, if $T_n' < T_n$, then we know that the new p-value is the area under the curve to the right of $T_n'$ and to the left of $-T_n'$. Referring to the graphic in this problem, we see that this means the p-value for $T_n'$ will be **larger** than the p-value for $T_n$.

Submit

You have used 1 of 2 attempts

Generating Speech Output ers are displayed within the problem

## Discussion

Hide Discussion

**Topic:** Unit 2 Foundation of Inference:Lecture 7: Hypothesis Testing (Continued): Levels and P-values / 10. Is the False Positives Rate Below 95 Percent?

Add a Post

Show all posts ▼ by recent activity ▼

Detecting false positives

I feel like we're missing something here as the machine learning algorithm data is only evaluated for benign tumors, surely in real world we'd want to evaluate the algorithm ... 3

**Audit Access Expires Dec 24, 2019**

You lose all access to this course, including your progress, on Dec 24, 2019.

Upgrade by Nov 4, 2019 to get unlimited access to the course as long as it exists on the site. **Upgrade now**

Learn About Verified Certificates



Generating Speech Output