edX

Hypothesis Testing - p-Values
Video

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- [Presenter] Hello and welcome back.

In the last lecture, we introduced hypothesis testing

and now we would like to discuss it a little more formally.

We're going to be a little more systematic

and a little more precise.

We'll discuss the significance level

which limits the amount of

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13.2_Hypotheis_testing_-_p_Values

POLL
If the statistic T is observed to be t, the p-value is

○　**The probability that T=t**

○　**The probability under the null hypothesis that T=t**

○　**The probability under the null hypothesis that T=t or is further**

towards the alternative hypothesis

◯ **None of the above**

Submit

1

2.0/2.0 points (graded)
One- and two-sided tests

We know the male students' height is approximately normal, and has standard deviation 4 inches. In a sample of 10 male students, the mean height is 68 inches. Calculate the p value corresponding to the following null hypotheses.

- H_0 : The average height of male students in this college is 70 inches.

H_1 : The average height of male students in this college is **not** 70 inches.

| 0.11384629800665805 | ✔ **Answer:** 0.11384629800665805 |

| 0.11384629800665805 |

Explanation
Since we take a sample of 10 students, the standard deviation of the sample mean is $4/\sqrt{10}$.
$P\left(N\left(0, 4/\sqrt{10}\right) \leq 2\right) = 0.9431$ Hence,
$P\left(\left|N\left(0, 4/\sqrt{10}\right)\right| > 2\right) = 2\left(1 - 0.9431\right) = 0.1138$

- H_0 : The average height of male students in this college is **at least** 70 inches.

H_1 : The average height of male students in this college **less than** 70 inches.

| 0.056923149003329024 | ✔ **Answer:** 0.056923149003329024 |

| 0.056923149003329024 |

Explanation
$P\left(N\left(0, 4/\sqrt{10}\right) \leq 2\right) = 0.9431$ Hence, $P\left(N\left(0, 4/\sqrt{10}\right) < -2\right) = \left(1 - 0.9431\right) = 0.0569$
.

Submit   You have used 1 of 4 attempts

ⓘ   Answers are displayed within the problem

2

0 points possible (ungraded)

The null hypothesis says that **at least** 20% of college students are left-handed. If we took a sample of 20 college students and let X be the number of lefties in the sample. Calculate the p values if

- $X = 1$

The checker accepts answers with tolerance 0.001

| 0.5 | ✖ **Answer:** 0.06917529027641081856 |

0.5

Explanation
The p value is $P(X \leq 1) = P(X = 0) + P(X = 1) = 0.069$

- $X = 2$

| | ✖ **Answer:** 0.20608471894847389696 |

Explanation
The p value is $P(X \leq 2) = P(X = 0) + P(X = 1) + P(X = 2) = 0.206$

| Submit | You have used 4 of 4 attempts |

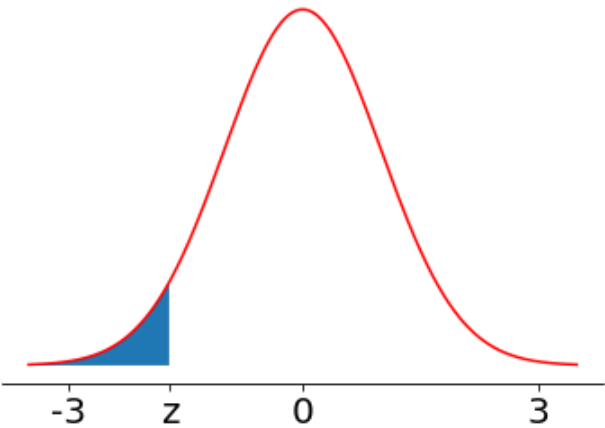🛈   Answers are displayed within the problem

3

0 points possible (ungraded)

The null hypothesis states that a random variable follows the standard normal distribution, while the alternative hypothesis states that the random variable has negative mean. Which of the following shaded areas represents the p value when the observed outcome is z?
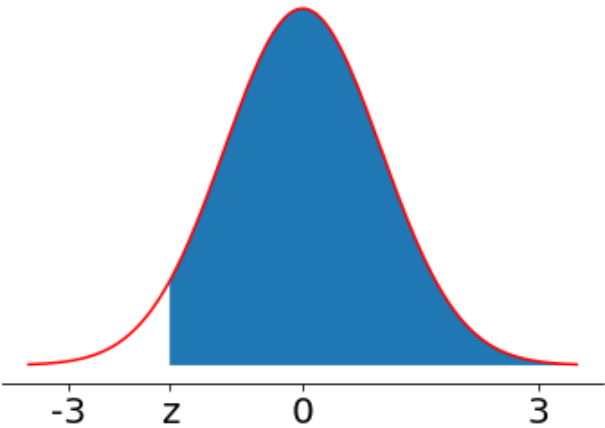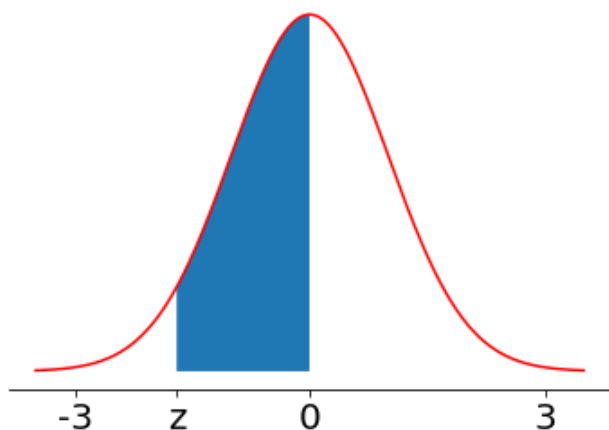
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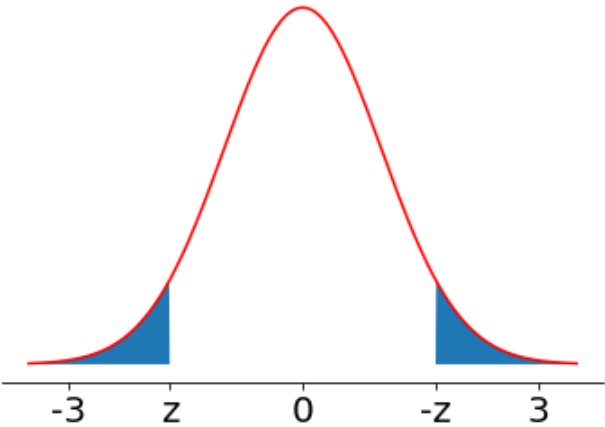
2

3

4

- ○ 1

- ◉ 2 ✔

- ○ 3

- ○ 4

Explanation
The alternative hypothesis is one-sided. According to definition the p value is $P\left(X \leq z\right)$.

| Submit | You have used 1 of 2 attempts |

ⓘ   Answers are displayed within the problem

4

6.0/6.0 points (graded)
In the following problem we discuss the test comparing two distribution means with the same variance. Assume $X \sim \mathcal{N}\left(\mu_1, \sigma^2\right)$, $Y \sim \mathcal{N}\left(\mu_2, \sigma^2\right)$, and they are independent.

- What is the variance of $X - Y$?

- ○ σ^2

- ◉ $2\sigma^2$ ✔

- ○ $\sigma^2/2$

Explanation

$$V(X-Y) = V(X) + V(-Y) = 2\sigma^2.$$

- If $\overline{X}$ is the sample mean of n independent random observations of X and $\overline{Y}$ is the sample mean of n independent random observations of Y, what distribution does $\overline{X} - \overline{Y}$ follow?

   ○ $\mathcal{N}\left(\mu_1 - \mu_2, \frac{\sigma^2}{n}\right)$

   ○ $\mathcal{N}\left(\mu_1 - \mu_2, \frac{\sigma^2}{2n}\right)$

   ◉ $\mathcal{N}\left(\mu_1 - \mu_2, \frac{2\sigma^2}{n}\right)$ ✔

Explanation

$$E(\overline{X} - \overline{Y}) = \mu_1 - \mu_2$$
$$V(\overline{X} - \overline{Y}) = V(\overline{X}) + V(-\overline{Y}) = \frac{2\sigma^2}{n}.$$

- We now want to test the null hypothesis H_0

$H_0 :$ In college, the average GPA of men is equal to the average GPA of women.
$H_1 :$ In college, the average GPA of men is different from the average GPA of women.

A sample of 10 men's GPA in college has sample mean 2.9, and a sample of 10 women's GPA has sample mean 3.1. We also know the GPAs of men and women have the same standard deviation 0.2. Calculate the p value.

The checker accepts answers with tolerance 0.001

| 0.025347318677468145 | ✔ **Answer:** 0.025347318677468145

0.025347318677468145

Explanation

Let $\overline{X}$ be the men's average GPA, $\overline{Y}$ be the women's average GPA.
The p value is $P\left(|\overline{X} - \overline{Y})| \geq |2.9 - 3.1|\right) = 0.025$ Under the null hypothesis,
$\frac{\overline{X} - \overline{Y}}{\sqrt{2\sigma^2/n}} \sim \mathcal{N}(0, 1).$

   Submit   You have used 4 of 4 attempts

   ⓘ   Answers are displayed within the problem

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