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The F-distribution - Quiz

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Question 1

0/1 point (graded)

True or False: Suppose you draw two random samples of size n_1 and n_2 from two different populations. $X_1 \sim N(\mu_1, \sigma_1^2)$ and $X_2 \sim N(\mu_2, \sigma_2^2)$. You estimate the sample variances, s_1^2 and s_2^2. The ratio of your estimates of the sample variances, $\frac{s_1^2}{s_2^2}$, follows an F distribution with $n_1 - 1, n_2 - 1$ degrees of freedom.

- a. True
- b. False ✖

Explanation

Recall that $s^2 = \frac{\sum(X_i - \bar{X})^2}{n-1}$, and $(n-1)s^2 \sim \chi^2_{n-1}$ for $i = 1, 2$. So

$$\frac{s_1^2}{s_2^2} \sim \frac{\chi^2_{(n_1-1)}/(n_1-1)}{\chi^2_{(n_2-1)}/(n_2-1)}$$

. And we know that the ratio of two independent chi squared distributions with n and m degrees of freedom respectively, divided by their degrees of freedom follows an F distribution with n, m. Letting $n = n_1 - 1$ and $m = n_2 - 1$, it is clear that the above statement is true.

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✖ Incorrect (0/1 point)

Question 2

1/1 point (graded)

Which distribution is useful for testing the following hypotheses:

Scenario A. You think the true variance is σ^2, and you want to use your data to make inferences about σ^2.

χ2 ✔ Answer: χ^2

Scenario B. You think the true mean is 0, and you want to use your data to test whether $\mu = 0$. You don't know the true variance.

t ✔ Answer: t

Scenario C: You want to compare the variances in two independent population

F ✔ Answer: F

- Exit Survey

Explanation

For **Scenario A**, since you know the that $(n-1)s^2 \sim \chi^2_{n-1}$, you can construct your test-statistic, and compare that to the χ^2 with $n-1$ degrees of freedom.

For **Scenario B**, as Professor Ellison explained in class, when the population variance is unknown, the standardized sample mean follows a t-distribution with $n-1$ degrees of freedom. So by comparing your test statistic to the t-distribution you can make inferences about the sample mean.

For **Scenario C**, as explained in question 1, we know that the ratio of the sample variances divided by the their degrees of freedom follows an F distribution if the variances are equal. So if you compare the test statistic you obtained with the F distribution, you can test whether the variances are in fact equal.

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✔ Correct (1/1 point)

Discussion

Topic: Module 7 / The F-distribution - Quiz

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