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3.
Two sample t-statistic

1/1 point (graded)

Let

- $X_1, \ldots, X_n \overset{\text{iid}}{\sim} N(\mu_0, \sigma_0^2)$
- $Y_1, \ldots, Y_m \overset{\text{iid}}{\sim} N(\mu_1, \sigma_1^2)$
- the X_i's are independent of the Y_i's,

where $\mu_0, \mu_1, \sigma_0^2, \sigma_1^2$ are **unknown** parameters.

What is the two-sample t-statistic $T_{n,m}$?

- $\left(\overline{X}_n - \overline{Y}_m\right) \sqrt{\left(\widehat{\sigma_1}^2 + \widehat{\sigma_0}^2\right) / (m+n)}$
- $\dfrac{\overline{X}_n - \overline{Y}_m}{\sqrt{\widehat{\sigma_1^2}/m + \widehat{\sigma_0^2}/n}}$

- $\dfrac{\overline{X}_n - \overline{Y}_m}{\sqrt{\sigma_1^2/m + \sigma_0^2/n}}$
- $\dfrac{\overline{X}_n - \overline{Y}_m}{\sqrt{\sigma_1^2 + \sigma_0^2}/(m+n)}$
- The t-statistic cannot be defined for two samples.

✔

Submit You have used 1 of 3 attempts

Answers are displayed within the problem

Distribution of t-statistic with Small Sample Size

2/2 points (graded)

Continuing with the setup as above, suppose the data you collected are summarized as follows:

- Sample sizes: $n = m = 5$;
- Sample means: $\overline{X}_n = 1.2$, $\overline{Y}_m = 1.0$;
- Sample variances: $\widehat{\sigma_1^2} = \widehat{\sigma_2^2} = 0.5$.

Which of the following distributions **best approximates** the distribution of the t-statistic $T_{n=5,m=5}$ under the null hypothesis $H_0 : \mu_0 = \mu_1$?

- Normal distribution with mean $\mu \neq 0$

Standard normal distribution

t-distribution

F-distribution

If applicable, specify the degrees of freedom of the distribution above (i.e. the distribution that **best approximates** the distribution of the t-statistic). If not applicable, enter -1.

Degrees of freedom: 8 **Answer:** 8

Solution:

Since the sample sizes are small, the two-sample T-statistic $T_{5,5} = \dfrac{\overline{X}_n - \overline{Y}_m}{\sqrt{\widehat{\sigma_1^2}/m + \widehat{\sigma_0^2}/n}}$ is approximated by a t-distribution with degree of freedom given by the Welsh-Satterthwaite formula. A sanity check is that the degree of freedom should be at least $\min m, n = 5$.

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Answers are displayed within the problem

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? Two sample t-statistic 1

I chose the last option for this question. Because I thought at this stage there is no hypothesis yet. And the test shall always based/related to the hypotheses. So at this step th...

	[Res] Degrees of freedom [note: unverified result, could be wrong] To "test" my answer of 8, I implemented the WelchSatterthwaite Formula (not really needed in this case, as n is equal to m): WelchSat...	4
	[Polling] What are your answers for this page? 1) 2nd choice 2) t-dist 3) 8	9
	[NOTE FROM STAFF] Last problem on this page small typo Staff	1
	[Staff] Typo in Deleted by MW-CTA Deleted by MW-CTA	3
?	[Staff]: you have an error in your sigma squared subscripts in the last question Hi, There is an error in your variance subscripts, these should be 0 and 1; there is no subscript 2. Not that it matters for the solutions since you made them equal; but would b...	2
	[staff]issue with the problem [...]	4
	[Edited by staff to remove exam content] [Edited by staff to remove exam content].	3

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