Date 11-02-2026

Full name (in CAPITAL LETTERS) _____ **SUNet ID** (the part before @stanford.edu) _____ **Section** (e.g., TUES 9:30) _____

Please write legibly so the teaching team can log your attendance: if we can't read your name, we can't give you credit.

PSYCH 10 · Fall 2026 · Worksheet for Lecture 12: Every model so far, and the logic of inference

Work through these with the people sitting next to you; the teaching team will help. Credit is for a good-faith effort, not for right answers. Hand it in before you leave.

Part 1 · Two models of body mass, one ANOVA table each

The two ANOVA tables below are for two models of the same outcome, the body masses of the 274 penguins: one with species as the explanatory variable, the other with flipper length. The questions ask for comparisons between the tables, not for arithmetic.

Model: species

	SS	df	MS	F	PRE
Model	128.2	1	128.2	558	0.67
Error	62.5	272	0.230		
Total	190.8	273			

Model: flipper length

	SS	df	MS	F	PRE
Model	148.5	1	148.5	955	0.78
Error	42.3	272	0.155		
Total	190.8	273			

a. SS Total is 190.8 in both tables. In one sentence, say why the two models have the same SS Total.

b. Which model is the better fit to the data? Write its name, then two quantities in the tables that show the better fit, with their values for both models.

c. Species is categorical and flipper length is quantitative, yet df Model is 1 in both tables. In one sentence, say what the 1 counts in each table.

d. For each statement, write *true* or *false*, then a few words giving your reason.

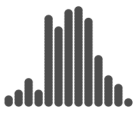
1. The flipper-length model removes more of SS Total than the species model.
2. The two models have the same degrees of freedom, so the one with the smaller SS Error has the larger F.
3. Fit to 548 penguins instead of 274, with the same PRE, the species model would have about the same F.
4. Together the two models account for 0.67 + 0.78 = 1.45 of SS Total.

1. _____ 2. _____

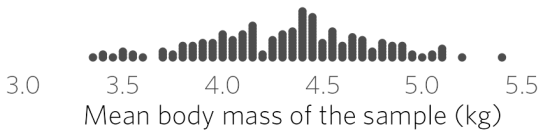
3. _____ 4. _____

Part 2 · From the sample to the population

Plot 1



Plot 2



Treating the 274 penguins as the population, a computer drew 200 random samples of 5 penguins and 200 random samples of 50 penguins, and computed the mean mass of each sample. Each dot is the mean mass of one sample; one plot shows the samples of 5, the other the samples of 50.

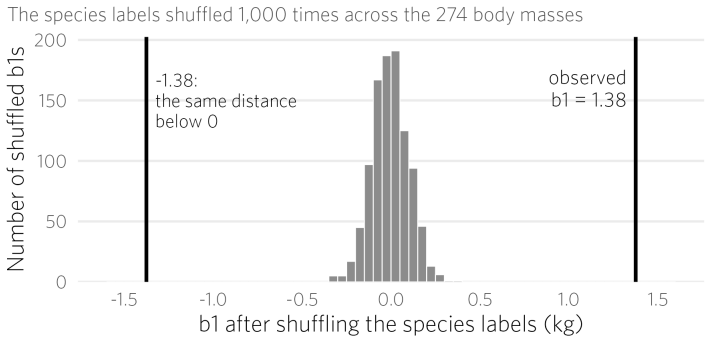
a. Which plot shows the samples of 50 penguins? Select one: *Plot 1* or *Plot 2*. Then write one sentence giving the reason.

b. A researcher weighs 500 penguins, all from one Adelie colony. Is the mean of that sample a better estimate of the mean mass of all Adelie and Gentoo penguins than the mean of a random sample of 50 penguins drawn from both species? Write *yes* or *no*, then one sentence giving the reason.

a. ☐ Plot 1 ☐ Plot 2 reason: _____

b. ☐ yes ☐ no reason: _____

Part 3 · Could the empty model have produced these data?



The species model of the 274 penguins' body masses gave b_1 = 1.38 kg, the Gentoo mean minus the Adelie mean. A computer then shuffled the species labels across the 274 masses 1,000 times, computing b_1 each time; the histogram shows those 1,000 shuffled b_1s.

a. In one sentence, say what process produced one shuffled b_1.

b. About how many of the 1,000 shuffled b_1s were at least as far from 0 as 1.38, in either direction? Write a whole number.

c. By the 5% convention, is the empty model rejected or kept? Write *reject* or *keep*, then a one-sentence reason that uses your answer to b.

a. _____

b. _____

c. _____

d. A study compares two groups, finds a difference between them, and reports p = 0.01. Each of the four sentences below offers an interpretation of that p-value. Write *justified* or *not justified* beside each sentence's number.

1. The study has proven that the empty model is wrong.
2. The probability that the empty model is correct is 1%.
3. If the study were repeated many times, 99% of the repeats would find a difference.
4. If the empty model were true, a difference at least this large would arise in 1% of samples.

d. 1. _____ 2. _____ 3. _____ 4. _____

e. A randomized study assigned 2,224 police officers to wear a body camera or not, then compared the two groups' use of force. The authors wrote: "We are unable to reject the null hypothesis that body-worn cameras have no effect on police use of force." (The null hypothesis is their name for the empty model.) Does this result show that the cameras have no effect? Write *yes* or *no*, then one sentence giving the reason.

e. _____

_____

Something new you learned today: _____