Quiz 12 - Solutions

-15 for incorrect test

Question 1:

1) null: nose length as usual, i.e., nose avg = 44 mm (1)
alternative: longer noses at PS, i.e., nose avg > 44 mm (1)

2) t-test:
- sample size = 18 (< 30)
- SD of nose unknown (we can only calculate SD of sample)
- nose lengths follow normal curve

observed avg = $\frac{41+57+\dots+37+48}{18} = 44.78$ mm (2)

expected avg = 44 mm

$$SD = \sqrt{\frac{(41-44.78)^2+(57-44.78)^2+\dots+(37-44.78)^2+(48-44.78)^2}{18}}$$

$$= \sqrt{\frac{837.11}{18}} = 6.82 \text{ mm} \quad (2)$$

$$SD_t = 6.82 \cdot \sqrt{\frac{18}{17}} = 7.02 \text{ mm} \quad (2)$$

$$SE_{sum} = \sqrt{18} \cdot 7.02 = 29.78 \text{ mm} \quad (2)$$

$$SE_{avg} = \frac{29.78}{18} = 1.65 \text{ mm} \quad (1)$$

$$t = \frac{44.78-44}{1.65} = 0.47 \quad (2), \quad df = 18-1 = 17 \quad (1)$$

3) P-value:

$t = 0.47$ is left of 0.69 (↓ 25%)

⇝ P-value is > 25% (2)

4) Conclusion:
- do not reject the null (P-value > 5%) (1)
- there is not enough evidence to say that students at Penn State on average have noses that are longer than 44 mm (1)

Question 2: -8 if any test conducted

We cannot conduct a 2-sample z-test (or any other test) here:

we have the whole populations, i.e., all student cars and all faculty cars registered with Parking Services – student cars are older on average!

Question 3: -8 for incorrect test

1) null: "A" students are evenly distributed, i.e., $\frac{1}{3}$ in front, $\frac{1}{3}$ in middle, $\frac{1}{3}$ in back (1)

alternative: "A" students are not evenly distributed, i.e., front : middle : back $\neq \frac{1}{3} : \frac{1}{3} : \frac{1}{3}$ (1)

2) χ^2-test:

Location	obs	exp	$\frac{(obs-exp)^2}{exp}$
Front	19	$\frac{1}{3} \cdot 33 = 11$	$\frac{(19-11)^2}{11} = 5.82$
Middle	9	$\frac{1}{3} \cdot 33 = 11$	$\frac{(9-11)^2}{11} = 0.36$
Back	5	$\frac{1}{3} \cdot 33 = 11$	$\frac{(5-11)^2}{11} = 3.27$
Total	33	33	9.45

(2)

$\chi^2 = 5.82 + 0.36 + 3.27 = 9.45$ (1)

$df = 3 - 1 = 2$ (1)

3) P-value:

$\chi^2 = 9.45$ is right of 9.21 ↓ 1%

$\rightsquigarrow$ P-value is $< 1\%$ (2)

4) Conclusion:

- reject the null (P-value $< 5\%$) (1)
- result is highly statistically significant (P-value even $< 1\%$) (1/2)
- there is strong evidence that "A" students are not evenly distributed in the classroom. (1/2)