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Quiz 5 **Spring 2017**

Problem 1: A computer programmer believes she has developed a new cross-platform application programming interface (API) to increase the speed at which the graphics processing unit (GPU) operates on computers. To confirm the application works, she runs it on a few computers before and after installing the new software. The data is summarized below:

Computer	1	2	3	4	5	6	7	8
Pre–Test (GHz)	2.2	2.7	2.5	3.2	3.0	2.9	2.0	2.7
Post–Test (GHz)	2.6	2.7	2.9	3.1	3.1	3.1	2.5	2.8

Assume that computer graphic processing speed is normally distributed. Test whether one can say that her new API improves computer graphic performance at the $\alpha = 0.05$ significance level.

Because the σ for the population is unknown, we need t-procedures. But the samples are on the same computers before and after, so that they are no independent. Therefore, we need a matched pairs t-test. Because the underlying population is normally distributed, the method is justified. The differences are below

Computer	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*
Diff (GHz)	*0.4*	*0*	*0.4*	-0.1	*0.1*	*0.2*	*0.5*	*0.1*

We have $\overline{x}_{Diff} = 0.3125$, $s_{Diff} = 0.348$, and $n = 8$. Then we have degrees of freedom $n - 1 = 7$. We have null and alternative hypotheses

$$\begin{cases} H_0 : \mu_{pre} = \mu_{post} \\ \\ H_a : \mu_{pre} < \mu_{post} \end{cases}$$

$$t = \frac{\overline{x}_{Diff} - 0}{s_{Diff}/\sqrt{n}} = \frac{0.3125}{0.348/\sqrt{8}} = 2.5399 \rightsquigarrow 0.000$$

Because $p < \alpha$, there is sufficient evidence to reject the null hypothesis. There is sufficient evidence to suggest that the processing time is, on average, faster after the software is installed.

Problem 2: In the early 1900s, perceptual psychologist Karl Zener designed a series of 5 cards, now called Zener cards, for experiments with his colleague parapsychologist J.B. Rhine. The cards consisted of 5 plain cards each with a unique symbol: a hollow circle, a Greek cross, three vertical wavy lines, a hollow square, and a 5-pointed star. These cards were used to test subjects for the possibility of ESP (extrasensory perception). Suppose you test a group of 57 self-acclaimed ESP individuals. Out of 200 presented cards, they collectively get 43 of the cards correct. Test the hypothesis that these individuals have some sort of ESP abilities at the significance level $\alpha = 1\%$.

This is a confidence interval for proportions. Because there are at least 10 successes and failures, the method is appropriate. We have $X = 43$*,* $n = 200$*, and* $\hat{p} = 43/200 = 0.215$*. Now*

$$\sigma_{\hat{p}} = \sqrt{\frac{p_0(1-p_0)}{n}} = \sqrt{\frac{0.20(0.80)}{200}} = 0.028$$

We have null and alternative hypotheses

$$\begin{cases} H_0 : p_0 = 0.20 \\ \\ H_a : p_0 > 0.20 \end{cases}$$

Note that $p_0 = 0.20$ *as random guessing obtains one an average of 1 out of 5 cards, i.e.* $1/5 = 0.20$*. Then*

$$z_{0.215} = \frac{\hat{p} - p_0}{\sigma_{\hat{p}}} = \frac{0.215 - 0.20}{0.028} = 0.54 \rightsquigarrow 0.7054$$

Then we have $p = 1 - 0.7054 = 0.2946$*. As* $p > \alpha$*, there is not sufficient evidence to reject the null hypothesis, i.e. self-acclaimed ESP individuals do no better than random guessing.*