Solutions to Midterm 1

Math 3080-1, Spring 2007, The University of Utah

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1. *In June 2002, the* Journal of Applied Psychology *reported on a study that examined whether the content of TV shows influenced the ability of the viewers to recall brand names of items featured in the commercials. The researchers randomly assigned volunteers to watch one of three programs, each containing the same nine commercials. One of the programs had violent content, another sexual content, and the third neutral content. After the shows ended the subjects were asked to recall the brands of products that were advertised. Results are summarized below:*

	Program Type		
	Violent	Sexual	Neutral
No. of subjects	108	108	108
Brands recalled			
Mean	2.08	1.71	3.17
Standard deviation	1.87	1.76	1.77

(a) *Do these results indicate that viewer memory for ads may differ depending on program content? Report the P-value.* [`This is for violent vs. neutral programs.`]

Solution: We are testing $H_0 : \mu_1 = \mu_2$ versus $H_a : \mu_1 \neq \mu_2$. Here, μ_1 is the true mean for programs of violent type, and μ_2 is for the neutral ones. The test statistic is

$$T = \frac{2.08 - 3.17}{\sqrt{\dfrac{1.87^2}{108} + \dfrac{1.77^2}{108}}} \simeq -4.4.$$

The T follows (approximately) a normal distribution since $n = m = 108$ is large. Therefore, the P-value can be found to be almost zero from a normal table. Reject H_0.

(b) *Compute a 95% confidence interval for the difference in mean number of brand names remembered between the groups watching shows with sexual content and those watching content-neutral shows.*

Solution: Again, the test statistic is almost normal, therefore we get the following 95% confidence interval for $\mu_{\text{sexual}} - \mu_{\text{neutral}}$:

$$1.71 - 3.17 \pm 1.96\sqrt{\frac{1.71^2}{108} + \frac{1.77^2}{108}} = -1.93 \text{ to } -0.9896.$$

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2. *Let μ denote the true average radioactivity level (pico-curies per liter). The value 5 pCi/L is considered the dividing line between safe and unsafe water. Which of the following two options would you recommend testing:*

(a) $H_0 : \mu = 5$ *versus* $H_a : \mu > 5$; *or*

(b) $H_0 : \mu = 5$ *versus* $H_a : \mu < 5$?

Solution: If we choose (a) and make a type-I error, then we are declaring unsafe water safe. If we choose (b) and make a type-I error, then we are declaring safe water unsafe. Since we can control type-I error, and not type-II, we need to opt for the less dangerous of the two; i.e., (b).

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3. *In a survey of 100 randomly chosen holders of a certain credit card, 57 said that they were aware that use of a credit card could earn them frequent-flyer miles on a certain airline. After an advertising campaign to build awareness of this benefit, an independent survey of 200 credit card holders was made, and 135 said that they were aware of the benefit. Can you conclude that awareness of the benefit increased after the advertising campaign? You must report the P-value as part of your answer.*

Solution: We are testing $H_0 : p_1 = p_2$ versus $H_a : p_1 < p_2$, where p_1 denotes the before proportion, and p_2 the after proportion. We compute, from the sample,

$$\hat{p}_1 = \frac{57}{100} = 0.57;$$
$$\hat{p}_2 = \frac{135}{200} = 0.675;$$
$$\hat{p} = \frac{57 + 135}{100 + 200} = 0.64.$$

The test statistic is
$$Z = \frac{0.57 - 0.675}{\sqrt{0.64 \times 0.36 \times \left[\dfrac{1}{100} + \dfrac{1}{200}\right]}} \simeq -1.786.$$

The P-value is approximately 0.036. Reject at 95%.