PRACTICE VIII

Inference

1. A D1 university recruiter claims that 10 percent of its baseball players ~~to~~ go on to play professionally after graduation. A reporter contacts a simple random sample (SRS) of baseball players who graduated during the past 20 years and finds that only 32 out of 450 went on to play professionally. Is there sufficient evidence to write an article disputing the university's claim? Give statistical justification for your conclusion.

$\hat{p} = \frac{32}{450}$ from sample of $n = 450$.

procedure: 1-sample one tailed z-test for p.

$H_0: p = 0.10$

$H_a: p < 0.10$

• where p = proportion of players who play professionally after graduation.

Check Conditions: We have a simple random sample, and 450 graduates is small (<10%) in relation to all graduates in 20 years.

$np = 45$ and $n(1-p) = 405$ are both greater than 10

Test Statistic and P-value: 1PropZTest gives $z = -2.0428$ and $p = 0.0205$.

(alternatively $\hat{p} = \frac{32}{400} = 0.0711$, $z = \frac{0.0711 - 0.1}{\sqrt{\frac{(0.1)(0.9)}{450}}}$

$= -2.0435$.

p-value: $P(z < -2.0435) = 0.0205$

Conclusion: With this small of a p-value $0.0205 < 0.05$ there is sufficient evidence to reject the null hypothesis. In other words, there is sufficient evidence that <10% of the university's baseball players go on to play professionally.

2. In the past years, 3 percent of all job applicants lied about their education. The HR division of a major company believes that the true figure is now higher and pans to investigate a simple random sample of applicants to test the hypothesis.

(a) Is it appropriate to run a one-proportion z-test on a SRS of 150 applicants? Explain why.

for a sample of $n = 150$ applicants and $p_o = 0.03$ we have $np_o = 150(0.03) = 4.5$, therefore the 'normality' condition for inference has not been met.

The SRS will be inappropriate.

(b) What is the minimum sample size necessary to run this hypothesis test?

for $np_o > 10$ we need $n(0.03) \geq 10$

or $n > \frac{10}{0.03} = 333.3$

so take $n = 334$.

(c) Suppose the HR division uses your results from part (b) and finds that 16 of the applicants lied about their salary. Is this sufficient evidence to say that the percentage of applicants lying about their salary is now over 3 percent?

Procedure: z-test for a proportion.

H.T. $H_o: p = 0.03$

$H_a: p > 0.03$

Conditions: This is a random sample, $np = 334(0.03) = 10.02$ and $n(1-p) = 334(0.97) = 323.98$ are ≥ 10. the sample is clearly less than 10% of the population.

Test statistic and P-value: 1-PropZTest gives $z = 1.918$ and $P = 0.028$

or $z = \dfrac{\frac{16}{334} - 0.03}{\sqrt{\frac{(0.03)(0.97)}{334}}} = 1.918$ and

$P(z > 1.918) = \boxed{0.028}$

Conclusion: with this small of a pvalue $0.028 < 0.05$, there is sufficient evidence to reject H_0. In other words, there is sufficent evidence to say that the percentage of applicants lying about their salary is now over 3 percent.

3. It is difficult to distinguish between marshmallows and mushrooms by taste alone if one is not allowed to see or smell. A person claims he can distinguish between these and the following test is designed. He will be given a sample of each in random order to taste while blindfolded with his nose pinched. This will be repeated 16 time. Let p be the proportion of times the person answers correctly.

(a) What are the null and alternate hypothesis?

$H_0: p = 0.5$

$H_a: p > 0.5$

• where p is the proportion of correct answers.

(b) Suppose he correctly answers 12 out of the 16 trials. What is the probability of answering exactly 12 of 16 is he is simply guessing?

This is a binomial distribution with $n = 16$, and $p = 0.5$. Let X be correct answers

$X \sim \text{binomial}(n = 16,\ p = 0.5)$

$P(X = 12) = \binom{16}{12}(0.5)^{12}(0.4)^{4} = 0.0278$

or use binompdf(_ , _) = 0.0278

(c) What is the p-value if he answers 12 of 16, and interpret this in context.

$X \sim \text{binomial}(16, 0.5)$

$p\text{-value} = P(X \geq 12) = 1 - P(X \leq 11) = 1 - \text{binomcdf}(16, 0.5, 11) = 0.0384$

If he was guessing the probability of getting a result this extreme or more would be $\boxed{0.0384}$.

(d) Is there sufficient evidence to reject the null hypothesis? Give an answer in context.

With this small of a p-value $0.0384 < 0.05$, there is sufficient evidence to reject H_0. In other words, there is sufficient evidence that he can distinguish between marshmallows and mushrooms by taste alone better than simply guessing.