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STA 296

BEYOND THE NUMBERS 5.1

Treatment Decision: Effective or Not?

Name: _____ Section Number: _____

To be graded, all assignments must be completed and submitted on the original book page.

EXHIBIT 1

Pumpkin Powered Prostates

Pumpkins and Prostate Health

Title: Pumpkin Seed Oil May Be a Halloween Treat

Author: Elena Conis

Source: *Los Angeles Times*, October 25, 2010, http://articles.latimes.com/2010/oct/25/health/la-he-nutrition-lab-pumpkin-20101025

In the News ...

According to the article in the *Los Angeles Times* by Elena Conis, for centuries pumpkin seeds have been a home remedy used to control or increase the frequency of urination in adults, children, and livestock. Knowing this about pumpkin seeds has prompted researchers to explore the possibility of a link between eating the seeds and better prostate health.

German researchers have been very involved in exploring this possible connection. The article summarized one study, the results of which were published in a German journal in 2000. According to the *Los Angeles Times*, the study:

> randomly selected among about 500 men to take either 1,000 milligrams of pumpkin seed oil extract or a placebo every day for 12 months. Symptoms improved in 65% of the men who took the oil, which the researchers interpreted as a promising (and statistically significant) result, even though symptoms also improved in 54% of the men who took the placebo.

Questions

1. Define the parameters of interest and state the null and alternative hypothesis.

P1 = proportion of men who took pumpkin seed oil for 12 months
P2 = proportion of men who took placebo for 12 months

H0 = P1=P2
HA = P1>P2

2. Should the null be rejected? Why or why not?

From the information given we are only told that P1=0.65 and P2=0.54 and that the results were statistically significant, so we would assume that H0 should be rejected.

Using StatKey to create a randomization plot for the difference in two proportions, shows that this has a p value = 0.071...so the data is significant above alpha=0.071 / 7.1% significance level.

EXHIBIT 2

Stutter Stopper?

Drugs for Stutterers

Title: Drug for Stutterers Shows Promise: Indevus Says Pill Reduced Incidents for Most in 1st Trial

Author: Stephen Heuser

Source: *Boston Globe,* May 25, 2006, http://www.boston.com/yourlife/health/diseases/articles/2006/05/25/drug_for_stutterers_shows_promise/

The following is an extract from a *Boston Globe* article on stuttering:

> A potential pill to treat stuttering took a step forward yesterday when Indevus Pharmaceuticals Inc. of Lexington said its experimental drug reduced stuttering in a majority of patients in its first clinical trial.
>
> The 132-patient trial is the largest human test ever conducted on a drug for stuttering, according to the company.
>
> ...
>
> The Indevus drug, called pagoclone, was given to 88 patients in escalating doses, with the rest of the trial subjects receiving a placebo. The patients were then tracked using several widely accepted measures of stuttering.
>
> ...
>
> On a third rating scale, based on doctors' impressions, the pagoclone patients scored a "numerically superior rating" to the placebo group, but the finding did not reach statistical significance.

Questions

1. Define the parameters of interest and state the null and alternative hypothesis

P1 = patients that received pill in escalating doses
P2 = patients that received placebo

H0= P1=P2
HA= P1>P2

2. Should the null be rejected? Why or why not?

We are not given any information on the effectiveness of the drug or placebo in regards to patients stuttering, so no conclusion can be made.

Based on the doctors qualitative assessments, the null hypothesis can not be rejected.

BEYOND THE NUMBERS 5.3

Statistical Significance in the Media—Part III

Name: _____ Section Number: _____

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EXHIBIT 1

Should I Eat My Vegetables?

Eat Your Veggies

Title: Eating Vegetables Doesn't Stop Cancer

Author: Tara Parker-Pope

Source: *New York Times,* April 8, 2010, http://well.blogs.nytimes.com/2010/04/08/eating-vegetables-doesnt-stop-cancer/

A recent *New York Times* article reported, "A major study tracking the eating habits of 478,000 Europeans suggests that consuming lots of fruits and vegetables has little if any effect on preventing cancer." The study, which was published in *The Journal of the National Cancer Institute*, "tracked 142,605 men and 335,873 women for an average of nearly nine years. Eating more vegetables was associated with a small but statistically significant reduction in cancer risk."

Questions

1. Define the parameters of interest and state the null and alternative hypothesis.

ρ (correlation) = correlation between fruit and vegetable consumption vs. cancer risk

H0: rho = 0
Ha: rho (does not equal) 0

2. What was the conclusion in their test? Did they reject H_0 or fail to reject H_0? How do you know?

This study found that there was a negative correlation between the consumption of fruit and cancer risk

The scientists rejected H0 the null hypothesis. We are not given enough information to test for oursevles, but the study states that the results were statistically significant so the p-value must have been below the alpha value for the study.

3. What do we know about the p-value compared to alpha?

I just mentioned this above, but the p-value must have been below the alpha value for the study

4. Which error could we be making (Type I or Type II)?

This study could have made a Type 1 Error, which is the rejection of a true null hypothesis (false positive)

BEYOND THE NUMBERS 5.8

Computations versus Understanding

Name: _____ Section Number: _____

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Introduction

It is important that you be able to compute correctly. However, computation prowess is no substitute for a deeper understanding of what you are doing and why. This is especially true in the field of statistical science. At the undergraduate level, computations are pretty easy. At all levels, however, the underlying concepts are challenging. The following activity will demonstrate and elucidate this divide.

EXHIBIT 1

Eureka or Not?

Suppose that twenty identical experiments are taking place simultaneously around the world. The researchers are all studying the same drug, which they hope will improve the survival rate of the black-winged peckerwood finch after it has been infected with a particular type of tree mold. The survival rate left untreated is unfortunately only 32%. None of the researchers know about the others' work. The table to the right shows the results from the 20 different studies. In all cases, the significance level was $\alpha = 0.05$ and the hypothesis being tested was:

$H_0: p = 0.32$

$H_A: p > 0.32$

TABLE 5.3 Finch Survival Rates

Site	Observed Survival Rate with Drug	Number of Finches Studied	Able to Reject $H_0: p \le 0.32$?
1	0.35	$n = 100$	No
2	0.34	$n = 100$	No
3	0.31	$n = 100$	No
4	0.33	$n = 100$	No
5	0.33	$n = 100$	No
6	0.35	$n = 100$	No
7	0.35	$n = 100$	No
8	0.33	$n = 100$	No
9	0.30	$n = 100$	No
10	0.34	$n = 100$	No
11	0.34	$n = 100$	No
12	0.30	$n = 100$	No
13	0.34	$n = 100$	No
14	0.31	$n = 100$	No
15	0.31	$n = 100$	No
16	0.31	$n = 100$	No
17*	**0.45**	**$n = 100$**	**Yes**
18	0.30	$n = 100$	No
19	0.35	$n = 100$	No
20	0.33	$n = 100$	No

Questions

1. Use the data from Site 17 to confirm that the null could be rejected. What is the *p*-value associated with the result?

Using StatKey and randomization test for a proportion, we see that the null hypothesis of p=0.32 would be rejected at alpha=0.05 because p-value is 0.003 for site 17 that has a proportion of 0.45.

2. Combine all of the studies ($n = 100 \times 20 = 2{,}000$) and test the hypothesis again. Confirm that it cannot be rejected. Report the overall observed survival rate and the *p*-value associated with the overall test.

Combining all tests gives an overall observed survival rate of 0.334 (667/2000). This gives a p-value of 0.087 and thus the null hypothesis of 0.32 cannot be rejected at alpha=0.05.

3. We have a dilemma. Nineteen of the sites don't seek publication because their results are not significant. Site 17 gets published because the results produced there, with an identical experiment, are significant. We know (though the researchers don't) that if we combine the results from all 20 sites, we will not be able to support the alternative. Describe what it means to have a Type I error rate of $\alpha = 0.05$, and explain what has likely happened here in light of that definition.

A type1 error is rejecting a true null hypothesis, which is what happened with site 17. At alpha=0.05, 5% of statistics give p-values of less than 0.05...which is what happened here (see question 1). Although the probability of a type 1 error is only 5%, this site 17 falls in here.

4. Do you think a ground-breaking scientific study should be replicated before it can be published? Why or why not? What steps should the scientific community take to improve study validity?

BEYOND THE NUMBERS 5.9

Role of Sample Size

Name: _____ Section Number: _____

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EXHIBIT 1

Better than Chance?

You have spent a great deal of time so far testing hypotheses involving proportions. Let's focus on the one-tailed version for the moment.

$$H_0: p = p_0$$

$$H_A: p > p_0$$

Suppose that you are developing a new pill designed to help students guess better on yes/no test questions. If students guess totally at random, they have a 50–50 chance of getting it right. You want to show that students perform better after taking your pill so that you can get create some interest in crowd-based funding for production and marketing costs. Unfortunately, when testing the pill's effectiveness, you always ended up with 51% of the treatment group getting their yes/no questions correct.

Questions

1. Consider the following hypothesis. Complete the entries in the table below for the different sample sizes shown. Remember that $\hat{p}$ is 0.51 in all cases.

$$H_0: p = 0.50$$

$$H_A: p > 0.50$$

TABLE 5.4 Hypothesis Results

Sample Size	One-Tailed *p*-Value	Statistically Significant Results? (yes or no)
100	0.418	no
1,000	0.269	no
10,000	0.017	yes at 1.7% level
100,000	0.000	yes

2. Look at the table. What happens to the *p*-value as the sample size increases?

As the sample size increases, the p-value decreases and the proportion eventually becomes statistically significant.

3. After you ran enough people through your study, you were able to report that your results were statistically significant and that you would begin seeking funding. Give and defend two reasons why you are still likely to have an unconvincing case.

EXHIBIT 2

Crowd Control

Title: Duration of Sleep Contributes to Next-Day Pain Report in the General Population

Author: R. Edwards, et al.

Source: *Pain 137* (2008) 202–207.

The authors of this study interviewed participants from the general population. These participants recorded both the number of hours they slept during the previous sleep period and the frequency of their pain symptoms. Pain was recorded on a five-point scale. A summary of the resulting data is presented in the table below:

Question

1. A comparison of patients in the 0–3 hour category to those in the 11+ hour category is not statistically significant, despite a difference in means of 0.42. However, a comparison of patients in the 5-hour category to those in the 8-hour category *is* statistically significant, even though the difference in means is only 0.19. Give a solid reason as to why you think this is so. What practical implication does this have for our understanding of testing results?

TABLE 5.5 Pain Relief Results

Sleep (Hours)	Average Pain Rating	Standard Deviation	Sample Size
0–3	1.36	1.51	75
4	1.13	1.36	166
5	0.94	1.29	434
6	0.79	1.11	1,138
7	0.73	1.11	1,568
8	0.75	1.13	1,557
9	0.71	1.09	339
10	1.24	1.4	119
11+	1.78	1.59	66