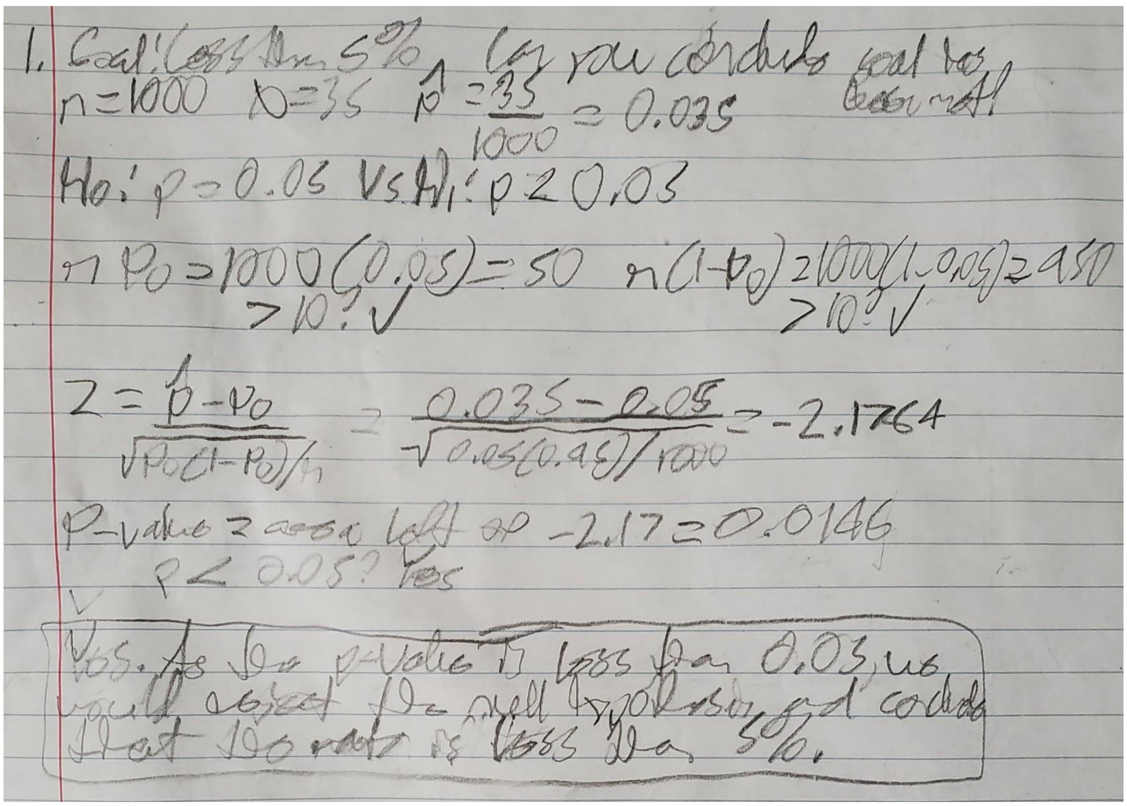
STAT 50 HW #18

Section 6.3 #'s 1, 3, 5, 7, 9

1.

Integrated circuits consist of electric channels that are etched onto silicon wafers. A certain proportion of circuits are defective because of “undercutting,” which occurs when too much material is etched away so that the channels, which consist of the unetched portions of the wafers, are too narrow. A redesigned process, involving lower pressure in the etching chamber, is being investigated. The goal is to reduce the rate of undercutting to less than 5%. Out of the first 1000 circuits manufactured by the new process, only 35 show evidence of undercutting. Can you conclude that the goal has been met?



1. Goal: Less than 5%, Can you conclude goal has been met?

$n = 1000$ $x = 35$ $\hat{p} = \frac{35}{1000} = 0.035$

$H_0: p = 0.05$ vs $H_1: p < 0.05$

$n p_0 = 1000(0.05) = 50 > 10?$ ✓ $n(1-p_0) = 1000(1-0.05) = 950 > 10?$ ✓

$$z = \frac{\hat{p} - p_0}{\sqrt{p_0(1-p_0)/n}} = \frac{0.035 - 0.05}{\sqrt{0.05(0.95)/1000}} = -2.1764$$

P-value = area left of $-2.17 = 0.0146$

$P < 0.05$? Yes ✓

$\boxed{\text{Yes. As the p-value is less than 0.05, we would reject the null hypothesis and conclude that the rate is less than 5\%.}}$

3.

Do bathroom scales tend to underestimate a person's true weight? A 150 lb test weight was placed on each of 50 bathroom scales. The readings on 29 of the scales were too light, and the readings on the other 21 were too heavy. Can you conclude that more than half of bathroom scales underestimate weight?

3. 1SO IL Test

Can you conclude more than half of scales underestimate weight?

$n = 50$ $X_L = 29$ $X_H = 21$

We can ignore scales that were too high.

$\hat{p} = \frac{29}{50} = 0.58$

$H_0: p = 0.5$ vs. $H_1: p > 0.5$

$np_0 = 50(0.5) = 25 > 10?$ ✓ $n(1-p_0) = 50(1-0.5) = 25 > 10?$ ✓

$$z = \frac{\hat{p} - p_0}{\sqrt{p_0(1-p_0)/n}} = \frac{0.58 - 0.5}{\sqrt{0.5(0.5)/50}} = 1.13$$

P-value = area right of 1.13 → 0.8708

$1 - 0.8708 = 0.1292$

$p < 0.05?$ ✗ $p < 0.1?$ ✗ $p < 0.01?$ ✗

$\boxed{\text{No. As the p-value is larger than any of the commonly used significance levels, there is little evidence that the population proportion of scales underestimated the weight by more than half. In fact, a result would occur by chance nearly 13\% of the times.}}$

5.

In a survey of 500 residents in a certain town, 274 said they were opposed to constructing a new shopping mall. Can you conclude that more than half of the residents in this town are opposed to constructing a new shopping mall?

5. $n = 800$ $x = 274$

Can you conclude more than half were opposed to building a new shopping mall?

$H_0: p \le 0.5$ vs. $H_1: p > 0.5$ $\hat{p} = \frac{274}{800} = 0.548$

$np_0 = 800(0.5) = 280$ $>10?$ ✓ $n(1-p_0) = 800(1-0.5) = 280$ $>10?$ ✓

$z = \frac{\hat{p} - p_0}{\sqrt{p_0(1-p_0)/n}} = \frac{0.546 - 0.5}{\sqrt{0.5(0.5)/800}} = 2.1466$

p-value = area right of $2.15 \rightarrow 0.9842$

$1 - 0.9842 = 0.0158$

$p < 0.05?$ ✓

$\boxed{\text{Yes. As the p-value is less than 0.05, we would reject the null hypothesis and conclude that more than half are opposed to a new shopping mall.}}$

7.

The article “Developing a Tool to Measure the Factors Influencing Nurses' Enjoyment of Nursing” (L. Wilkes, M. Doull, et al., Journal of Clinical Nursing, 2016:1854–1860) reports that in a sample of 124 nurses, 54 said that a busy workload had a positive effect on their enjoyment of their job. Can you conclude that less than 45% of nurses feel that a busy workload has a positive effect on their enjoyment of their job?

7. $n = 124$ $x = 54$

Can you conclude that <48% of nurses feel that a busy workload has a positive effect on their enjoyment of a job?

$\hat{p} = \frac{54}{124} = 0.435$

$H_0: p = 0.45$ vs. $H_1: p < 0.45$

$np_0 = 124(0.45) = 55.8 \geq 10?$ ✓ $n(1-p_0) = 124(0.55) = 68.2 \geq 10?$ ✓

$$z = \frac{\hat{p} - p_0}{\sqrt{p_0(1-p_0)/n}} = \frac{0.435 - 0.45}{\sqrt{0.45(0.55)/124}} = -0.3249$$

-0.32

p-value = area left of $-0.3249 = 0.3707$

$p < 0.05?$ ✗ $p < 0.1?$ ✗ $p < 0.01?$ ✗

No. As the p-value is larger than any of the commonly used significance levels, there is little evidence that the true population proportion of nurses that feel that a busy workload has a positive effect on their enjoyment is less than 48%. In fact the result might occur by chance 37% of the time.

9.

Let A and B represent two variants (alleles) of the DNA at a certain locus on the genome. Assume that 40% of all the alleles in a certain population are type A and 30% are type B. The locus is said to be in Hardy-Weinberg equilibrium if the proportion of organisms that are of type AB is (0.40)(0.30) = 0.12. In a sample of 300 organisms, 42 are of type AB. Can you conclude that this locus is not in Hardy-Weinberg equilibrium?

a. $n = 300$ $b = 42$

$p_a = 0.40$ $p_b = 0.30$ $p_{ab} = 0.12$

Can you conclude the locus is not in Hardy-Weinberg equilibrium?

$\hat{p} = \frac{42}{300} = 0.14$

$H_0: p = 0.12$ vs. $H_1: p \neq 0.12$

$np_0 = 300(0.12) = 36$ $n(1-p_0) = 300(1-0.12) = 264$

$> 10?$ ✓ $> 10?$ ✓

$z = \frac{\hat{p} - p_0}{\sqrt{p_0(1-p_0)/n}} = \frac{0.14 - 0.12}{\sqrt{0.12(0.88)/300}} = 1.066$

p-value = area left of -1.07 and right of 1.07

$2P(Z < -1.07) = 2(0.1423) = 0.2846$

$p < 0.05?$ ✗ $p < 0.1?$ ✗ $p < 0.01?$ ✗

No. As the p-value is larger than any of the commonly used significance levels there is little evidence that the locus is in Hardy-Weinberg equilibrium. In fact a result might occur by chance 29% of the time.