Lab 14: Chapter 10

1. In a 2009 nonscientific poll on www.ESPN.com 67% of the respondents believed that Roger Federer was going to defeat Andy Roddick in the 2009 Wimbledon Gentlemen's singles championship. Suppose that a survey of 150 tennis fans conducted in Europe at the same time resulted in 118 who believed that Federer was going to win. Perform a hypothesis test to determine if it is reasonable to conclude that the percentage of all European tennis fans who believed that Federer was going to win the 2009 championship was higher than 67%, the result in the ESPN.com poll. Use a 2% significance level.

   $n=150$

   $X=118$

   $\hat{p}=\frac{X}{n}$

   $> 67\%$

   $\alpha=0.02$

2. Women athletes at the University of Colorado, Boulder, have a long-term graduation rate of 67% (Source: Chronicle of Higher Education). Over the past several years, a random sample of 48 women athletes at the school showed that 26 eventually graduated. Does this indicate that the population proportion of women athletes who graduate from the University of Colorado, Boulder, is now less than 67%? Use a 5% level of significance.

   $\alpha=$

3. Is the national crime rate really going down? Some sociologists say yes! They say that the reason for the decline in crime rates in the 1980s and 1990s is demographics. It seems that the population is aging, and older people commit fewer crimes. According to the FBI and the Justice Department, 70% of all arrests are of males aged 15 to 34 years. Suppose you are a sociologist in Rock Springs, Wyoming, and a random sample of police files showed that of 36 arrests last month, 27 were of males aged 15 to 34 years. Use a 1% level of significance to test the claim that the population proportion of such arrests in Rock Springs is different from 70%.

4. A research center claims that at most 75% of U.S. adults think that drivers are safer using hands-free cell phones instead of using hand-held cell phones. In a random sample of 160 U.S. adults, 77% think that drivers are safer using hands-free cell phones instead of hand-held cell phones. At $\alpha = 0.01$, is there enough evidence to reject the center's claim?

5. When working properly, a machine that is used to make chips for calculators does not produce more than 4% defective chips. Whenever the machine produces more than 4% defective chips, it needs an adjustment. A factory worker who works next to the machine all day claims that the machine needs adjusting. To check if the machine is working properly, the quality control department at the company often takes samples of chips and inspects them to determine if they are good or defective. One such random sample of 300 chips taken recently from the production line contained 16 defective chips. Test the factory worker's claim that the machine is producing more than 4% defective chips. Use a level of significance equal to 1%.

① p = the actual % of European fans who thought Federer was going to win.

problem 1
LAB 14

$n = 150$ people

X = the binom. RV
the number of people who thought federer will win.

Step 1

H_0 : $p = 0.67$ — $p_0 = 0.67$

H_A : $p > 0.67$ — $p > p_0$

Step 2

Is the sample or rep. of the pop. ? ✓

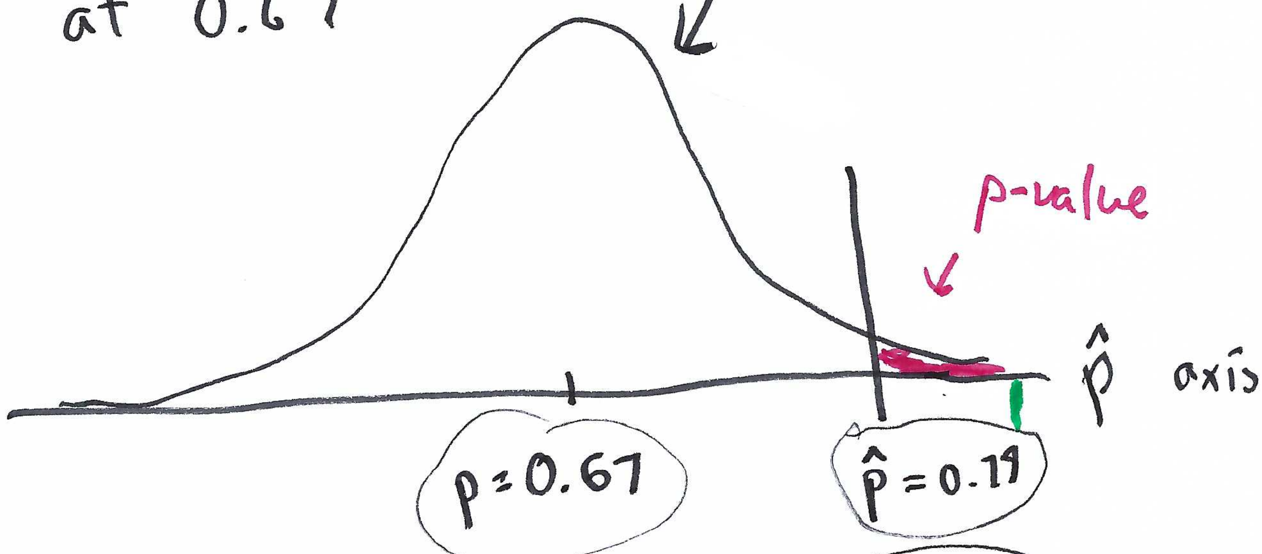
Is $n \cdot p_0 \geq 10$ AND $n(1 - p_0) \geq 10$

$150 \cdot (0.67) \doteq \boxed{100}$ And $(150)(1 - 0.67) \doteq \boxed{50}$

Step2 We can assume the sampling dist of $\hat{p}$ is approx normal, but the problem doesn't indicate whether the sample was random.

z-score

Step 3 Assume in Step1, that H_0 is correct. This centers the sampling distn. of $\hat{p}$ at 0.67



The sample %, $\boxed{\hat{p} = \frac{118}{150} = 0.79.}$ sample statistic

The test statistic, is the z-score of $\hat{p}$

is given by the formula

$$Z = \frac{\hat{p} - p_0}{\sqrt{\frac{p_0(1-p_0)}{n}}}$$ and is

used to measure the distance between $\hat{p}$ and p_0 (the estimation error).

$$Z = \frac{0.79 - 0.67}{\sqrt{\frac{0.67(1-0.67)}{150}}} = \boxed{3.0388}$$ St. Dev

use a ~~prop~~- "1-prop-Z-test" to get this value, and the p-value.

Step 4 (P-value)

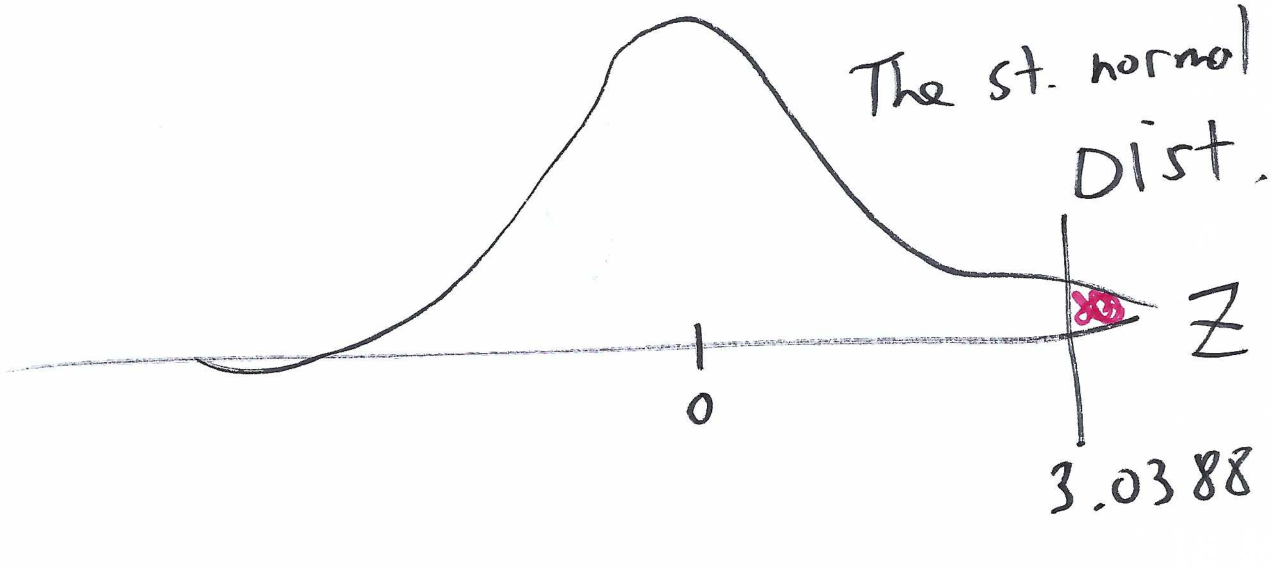
since we have a right-tailed test,

the p-value $= P(\hat{p} > 0.79$, assuming H_0 is correct$)$

$= \boxed{\begin{array}{c} 0.0012 \\ (0.12\%) \end{array}}$ use the 1-prop-z-test to get this

The p-val $= P(Z > 3.0388)$

$= \boxed{0.0012}$

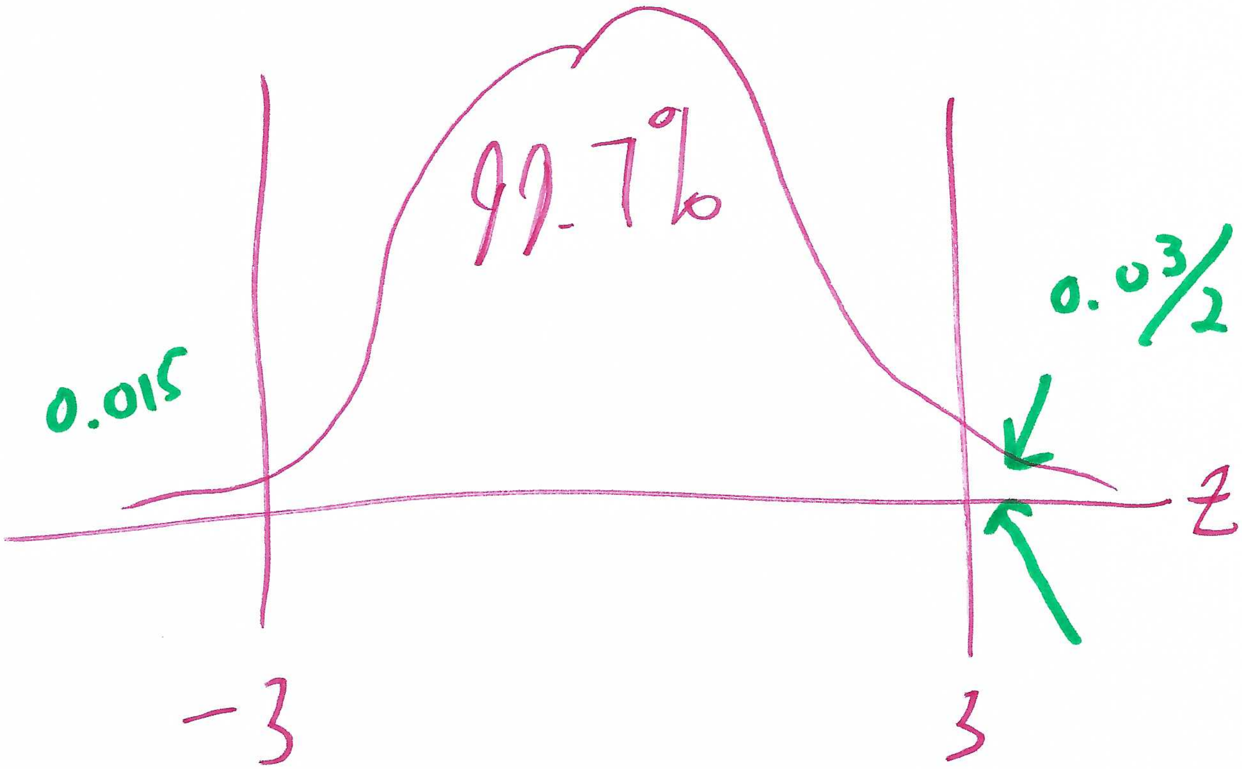


The problem says that $\alpha = 0.02$

Step 4 Since the

p-val $\leq \alpha$, we reject H_0.

Step 5 There is convincing sample evidance that the actual percentage of European fans who said Federer was going to win is higher than 67%.


99.7%
0.015
0.03/2
z
-3
3

(2) problem 2, lab 14

p = the actual % of women athletes at the university who eventually graduate

n = 48

x = the numb. of "yes" responses to the question "Did you eventually graduate?" = 26

$$\hat{p} = \frac{x}{n} = \frac{26}{48}$$

Step 1

$H_0: p = 0.67$

$H_A: p < 0.67$

$p_0 = 0.67$

left-tailed test

Step 2) Cond Check

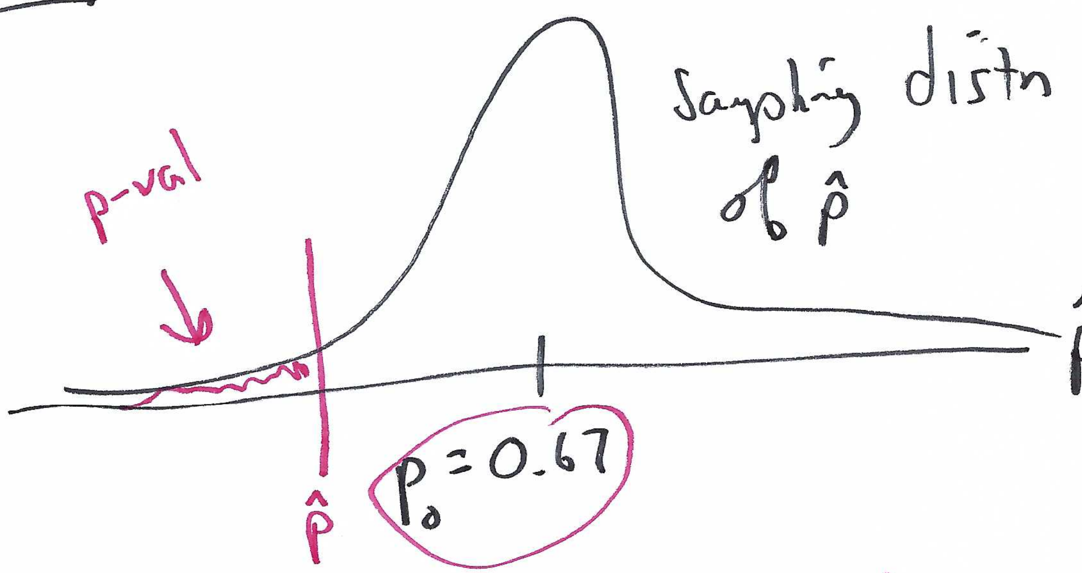
The sample is random ✓

$$n \cdot p_0 = 48(0.67) \doteq \boxed{32}$$

$$n(1-p_0) = 48(1-0.67) \doteq \boxed{16}$$

Both cond's check

Step 3 Assume Ho is correct.



1-prop-z test

$$Z = \frac{\hat{p} - p_0}{\sqrt{\frac{p_0(1-p_0)}{n}}} = \boxed{-1.89 \text{ St. Dev. lengths}}$$

Step 4 Since the test is left-tailed

$$\text{the p-val} = P(\hat{p} < 0.541\bar{6})$$

$$= P(z < -1.89)$$

$$= \boxed{0.0293}$$

1-prop-z-test

~~Same~~ $\alpha = 0.05$

and Since the p-val $\leq \alpha$,

Reject Ho

Step 5 There is convincing sample evidence that the actual % of women athletes who eventually graduate is less than 67%

3

Step 1

3

problem 3
Lab 14

H_0: $p = 0.70$

H_A: $p \neq 0.70$

$n = 36$
$x = 27$
$\alpha = 0.01$

$n \cdot p_0 = 36(0.7)$
$n(1-p_0) = 36(0.3)$

Step 2 The Sample is random ✓

and $n \cdot p_0 = \boxed{25.2}$

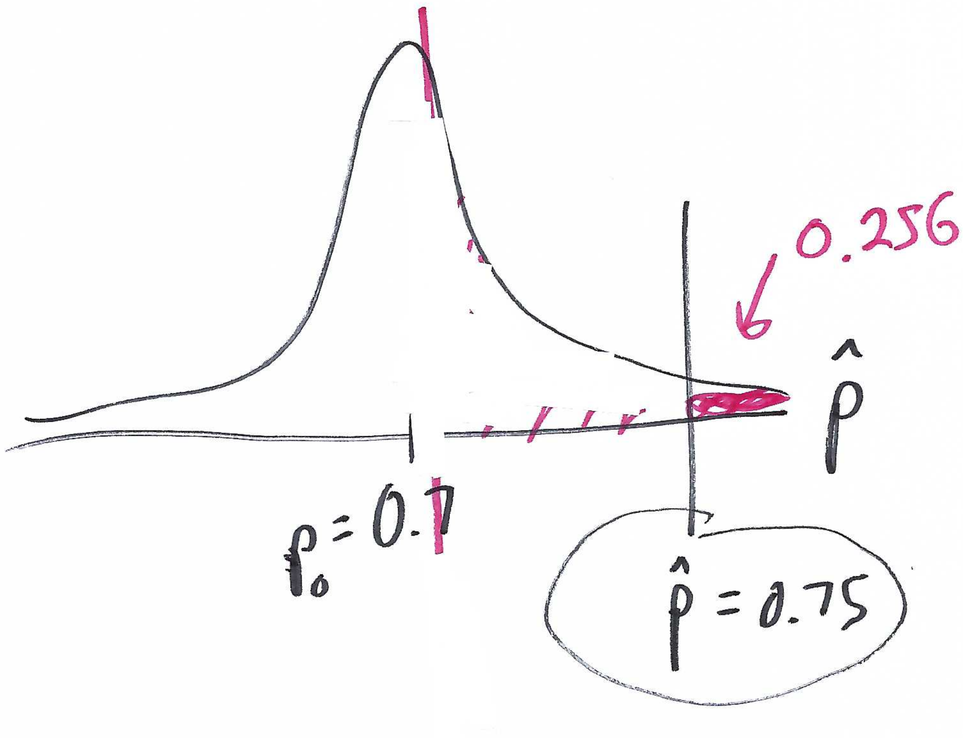
and $n(1-p_0) = \boxed{10.8}$

and both are ≥ 10.

Both cond's Check

Step 3 The z-score of $\hat{p}$ is

$\boxed{0.65}$



Step4 Since we a 2-tailed test and because the sample statistic is right of (more than) p_0, the p-val

$$\text{p-val} = 2 \cdot P\left(\hat{p} > 0.75, \text{ assuming } H_0 \text{ is correct}\right)$$

$$= \boxed{0.5127}$$

Step 4 Since $p\text{-val} > \alpha$,

fail to reject H_0

Step 5 There is not convincing

sample evidence that the actual % of monthy arrests in Rock Springs who were males ages 15 to 34 years is different from 70%.

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$p \le 0.75$, $n = 160$, $\hat{p} = 0.77$

4. A research center claims that at most 75% of U.S. adults think that drivers are safer using hands-free cell phones instead of using hand-held cell phones. In a random sample of 160 U.S. adults, 77% think that drivers are safer using hands-free cell phones instead of hand-held cell phones. At $\alpha = 0.01$, is there enough evidence to reject the center's claim?

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(4) Claim $p \leq 0.75$

Given Info

$n = 160$, $\hat{p} = 0.77$, $\alpha = 0.01$

Since $\hat{p} = \frac{x}{n}$, then $x = n \times \hat{p} = 160(.77) = 123.2$

$\rightarrow \boxed{x \approx 123}$

Guideline X is a binomial random variable, therefore x has to be a whole number $(0, 1, \ldots, n)$ between 0 and n. Recall that x is the number of successes ("yes" responses) in the sample of size n.

Warning The "1-Prop-Z-test" Command on the calculator will not work (an error message is created) if you do not set x to be a whole number.

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(4)

Step 4 Since the H_A has the greater than symbol in it, we have a right-tailed test, and the

$$\text{p-val} = P(\hat{p} > 0.77, \text{ assuming } H_0 \text{ is correct})$$

$$= P(z > 0.5477)$$

(See attached pictures on the next page)

$$= \boxed{0.2919} \quad (\text{or } 29.19\%)$$

Therefore, if we reject H_0, there is an approximately 29% chance of making a type I error.

Since the $\boxed{\text{p-value} > \alpha}$, the test fails to reject the null hypothesis.

(Step 5) There is not convincing sample evidence (of H_A) that the actual proportion of U.S. adults that think that drivers are safer using hands-free cell phones instead of hand-held cell phones is more than 75%.

(4) Step 1

$$\boxed{\begin{array}{l} H_0: p \leq 0.75 \\ H_A: p > 0.75 \end{array}} \text{ (or } p = 0.75\text{)}$$

Step 2 $\boxed{p_0 = 0.75}$, $n \times p_0 = 160(0.75) = \boxed{120}$

and $n \times (1-p_0) = 160(1-0.75) = \boxed{40}$

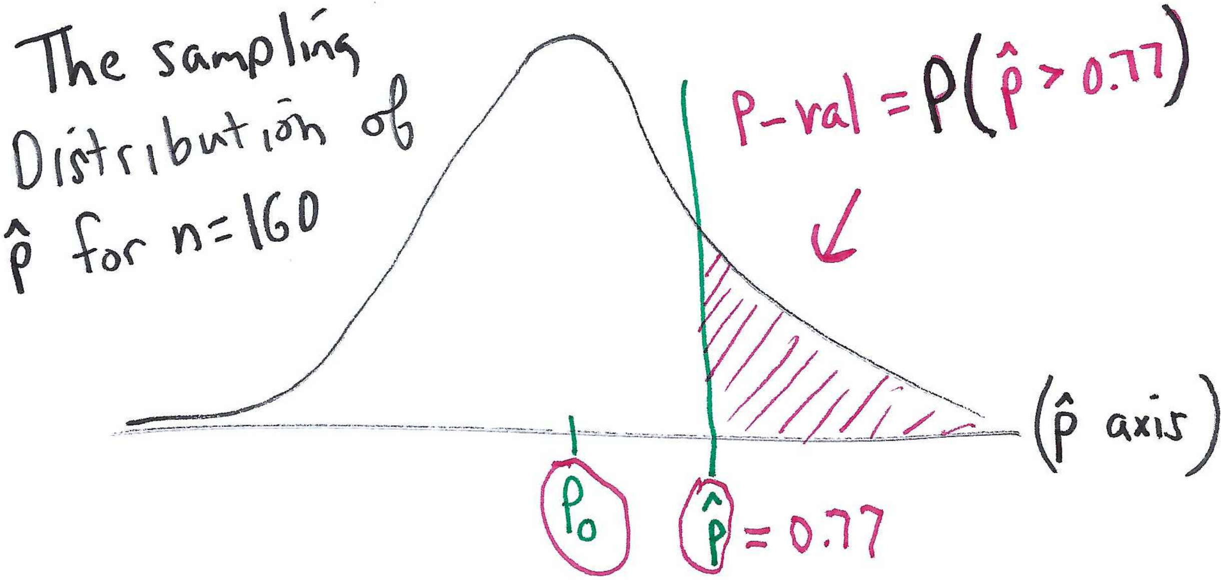
Since the sample is a random sample, and because there are at least 10 successes (120) and 10 failures (40) expected in a sample (If we assume H_0 is correct), the 1-prop-z-test is appropriate to use here.

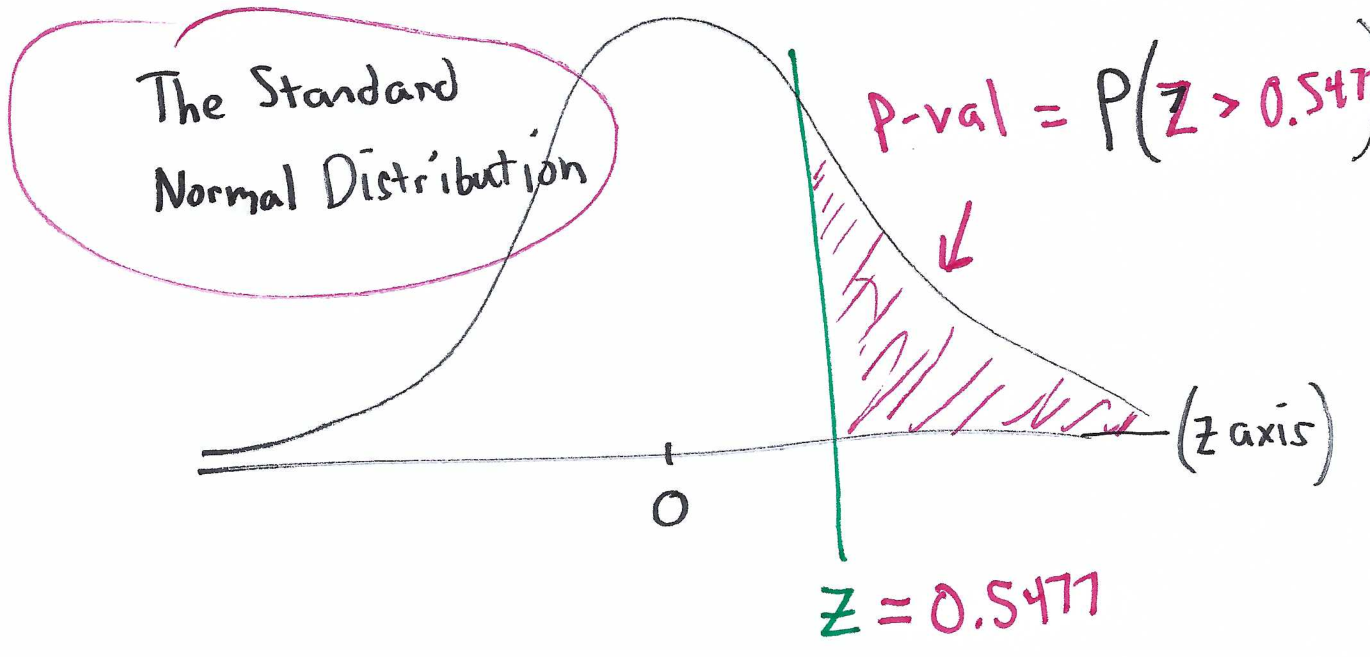
Step 3 The sample statistic is $\hat{p} = 0.77$

and the test statistic is

$$Z = \frac{\hat{p} - p_0}{\sqrt{\frac{p_0(1-p_0)}{n}}} = \boxed{0.5477 \text{ standard}} \text{ deviation lengths}$$

4


The sampling Distribution of $\hat{p}$ for $n=160$
P-val = $P(\hat{p} > 0.77)$
($\hat{p}$ axis)
p_0
$\hat{p} = 0.77$


The Standard Normal Distribution
P-val = $P(Z > 0.5477)$
(Z axis)
0
$Z = 0.5477$

5

Step 1

H_0: $p = 0.04$ (or $p \leq 0.04$)

H_A: $p > 0.04$

p = the actual percent of chips from the machine that are defective.

$n = 300$ chips

$x = 16$ defective chips

$\hat{p} = \frac{16}{300} = 0.05\bar{3}$ $(5.\bar{3}\,\%)$

Use $\alpha = 1\%$ $= 0.01$

Step 2 The sample is random. ~~There are 16 successes (defective chips) and 300 − 16~~ $n \times p_0 = 300(0.04) = 12$

and $n \times (1 - p_0) = 300(1 - 0.04) = 288$

~~So there are at least~~ 10 So, a 1-prop-z test is appropriate

Step3 The sample statistic is $\hat{p} = 0.05\bar{3}$

The test statistic is

$$Z = \frac{\hat{p} - p_0}{\sqrt{\frac{p_0(1-p_0)}{n}}} = \boxed{1.1785}$$

Step4 Since H_A has a $>$ symbol, we have a rt.-tailed test and

$$\text{p-val} = P(\hat{p} > 0.04, \text{ assuming } H_0 \text{ is correct})$$

$$= P(Z > 1.1785)$$

$$= \boxed{0.1193}$$

Since p-val $> \alpha$, fail to reject H_0.

Step5

There is not convincing evidence that the actual percent of defective chips is more than 4%. The machine may not be out of calibration. ~~If the machine needs adjustment, then we got~~