Math 183 HW14, Name: Chandler Blaid Burgess, **PID:** A98029477

6.12 Legalization of marijuana, Part I. The 2010 General Social Survey asked 1,259 US residents: "Do you think the use of marijuana should be made legal, or not?" 48% of the respondents said it should be made legal.[44]

(a) Is 48% a sample statistic or a population parameter? Explain.

(b) Construct a 95% confidence interval for the proportion of US residents who think marijuana should be made legal, and interpret it in the context of the data.

(c) A critic points out that this 95% confidence interval is only accurate if the statistic follows a normal distribution, or if the normal model is a good approximation. Is this true for these data? Explain.

(d) A news piece on this survey's findings states, "Majority of Americans think marijuana should be legalized." Based on your confidence interval, is this news piece's statement justified?

a) 48% is a sample statistic, because it is a proportion of the 1259 in the sample

b) $n = 1259$ $\quad p = 0.48$ $\quad SE = \sqrt{\frac{(.48)(0.52)}{1259}} = 0.014$ $\quad z = 1.96$

\# of successes $= n \cdot p \approx 604$ ✓

\# of failures $= n(1-p) \approx 654$ ✓

$CI = 0.48 \pm 1.96 \cdot SE$

$CI = [0.452, 0.508]$ 95% confident the mean of the population will fall between the interval

c) Yes, weve checked the # of successes & failures. They are both ok and unskewed.

d) No, because the mean could very well be as low as 45.2%.

6.16 Is college worth it? Part I. Among a simple random sample of 331 American adults who do not have a four-year college degree and are not currently enrolled in school, 48% said they decided not to go to college because they could not afford school.[49]

(a) A newspaper article states that only a minority of the Americans who decide not to go to college do so because they cannot afford it and uses the point estimate from this survey as evidence. Conduct a hypothesis test to determine if these data provide strong evidence supporting this statement.

(b) Would you expect a confidence interval for the proportion of American adults who decide not to go to college because they cannot afford it to include 0.5? Explain.

a) $H_0: \mu = 0.5 \quad H_A: \mu < 0.5$

$n = 331$

$p = 0.48$

$z = 1.645$

$SE = \sqrt{\dfrac{(0.48)(0.52)}{331}} = 0.0275$

$CI = 0.48 \pm 1.645 \cdot 0.0275$

$CI = [0.435, 0.525]$

H_0 is not rejected.

b) Yes, we would be 90% confident that the proportion would fall within the range given above.

6.20 Legalize Marijuana, Part II. As discussed in Exercise 6.12, the 2010 General Social Survey reported a sample where about 48% of US residents thought marijuana should be made legal. If we wanted to limit the margin of error of a 95% confidence interval to 2%, about how many Americans would we need to survey ?

$p = 0.48$

$me = 0.02$

$z = 1.96$

$me = z \cdot se$

$\Rightarrow se = \frac{me}{z}$

$Se = \frac{0.02}{1.96} = 0.01$

$se = \sqrt{\frac{p(1-p)}{n}}$

$se^2 = \frac{p(1-p)}{n}$

$n = \frac{p(1-p)}{se^2} = \frac{(0.48)(0.52)}{(0.01)^2}$

$\boxed{n = 2398}$

6.22 Acetaminophen and liver damage. It is believed that large doses of acetaminophen (the active ingredient in over the counter pain relievers like Tylenol) may cause damage to the liver. A researcher wants to conduct a study to estimate the proportion of acetaminophen users who have liver damage. For participating in this study, he will pay each subject $20 and provide a free medical consultation if the patient has liver damage.

(a) If he wants to limit the margin of error of his 98% confidence interval to 2%, what is the minimum amount of money he needs to set aside to pay his subjects?

(b) The amount you calculated in part (a) is substantially over his budget so he decides to use fewer subjects. How will this affect the width of his confidence interval?

a) $me = 0.02$

$z = 2.33$

$p = 0.5$

$Se = \frac{me}{z} = 0.0086$

$n = \frac{p(1-p)}{se^2} = \frac{0.25}{se^2} = 3383$

$\$ = 3383 * 20$

$\boxed{\$ = 67660}$

b) To reduce amount spent he would have to reduce number of subjects increasing margin of error, and decreasing the confidence interval.

6.26 The Daily Show A 2010 Pew Research foundation poll indicates that among 1,099 college graduates, 33% watch The Daily Show. Meanwhile, 22% of the 1,110 people with a high school degree but no college degree in the poll watch The Daily Show. A 95% confidence interval for $(p_{\text{college grad}} - p_{\text{HS or less}})$, where p is the proportion of those who watch The Daily Show, is (0.07, 0.15). Based on this information, determine if the following statements are true or false, and explain your reasoning if you identify the statement as false.

(a) At the 5% significance level, the data provide convincing evidence of a difference between the proportions of college graduates and those with a high school degree or less who watch The Daily Show.

(b) We are 95% confident that 7% less to 15% more college graduates watch The Daily Show than those with a high school degree or less.

(c) 95% of random samples of 1,099 college graduates and 1,110 people with a high school degree or less will yield differences in sample proportions between 7% and 15%.

(d) A 90% confidence interval for $(p_{\text{college grad}} - p_{\text{HS or less}})$ would be wider.

(e) A 95% confidence interval for $(p_{\text{HS or less}} - p_{\text{college grad}})$ is (-0.15,-0.07).

a) Yes, because '0' (no change) is not w/in the interval.

b) False, The difference is between 7% & 15% w/ 95% confidence

c) True

d) False, narrower to attempt a more accurate range w/ less confidence

e) True

6.28 Sleep deprivation, CA vs. OR, Part I. According to a report on sleep deprivation by the Centers for Disease Control and Prevention, the proportion of California residents who reported insufficient rest or sleep during each of the preceding 30 days is 8.0%, while this proportion is 8.8% for Oregon residents. These data are based on simple random samples of 11,545 California and 4,691 Oregon residents. Calculate a 95% confidence interval for the difference between the proportions of Californians and Oregonians who are sleep deprived and interpret it in context of the data.[53]

In addition to answering the question, write a single line of code in R that checks that your 95% CI is correct.

$n_c = 11545 \quad n_o = 4691$

$p_c = 0.08 \quad p_o = 0.088$

$z = 1.96$

$$Se = \sqrt{\frac{p_c(1-p_c)}{n_c} + \frac{p_o(1-p_o)}{n_o}}$$

$Se = 0.0049$

$CI = |(p_c - p_o)| \pm z \cdot Se$

$= (+0.008) \pm 1.96 \cdot 0.0049$

$= [-0.0015, 0.0175]$

$\boxed{> CI = data.frame(lb = |(p_c - p_o)| - me, ub = |(p_c - p_o)| + me)}$

6.32 Full body scan, Part I. A news article reports that "Americans have differing views on two potentially inconvenient and invasive practices that airports could implement to uncover potential terrorist attacks." This news piece was based on a survey conducted among a random sample of 1,137 adults nationwide, interviewed by telephone November 7-10, 2010, where one of the questions on the survey was "Some airports are now using 'full-body' digital x-ray machines to electronically screen passengers in airport security lines. Do you think these new x-ray machines should or should not be used at airports?" Below is a summary of responses based on party affiliation.[55]

		Party Affiliation		
		Republican	Democrat	Independent
Answer	Should	264	299	351
	Should not	38	55	77
	Don't know/No answer	16	15	22
	Total	318	369	450

(a) Conduct an appropriate hypothesis test evaluating whether there is a difference in the proportion of Republicans and Democrats who think the full-body scans should be applied in airports. Assume that all relevant conditions are met.

(b) The conclusion of the test in part (a) may be incorrect, meaning a testing error was made. If an error was made, was it a Type 1 or a Type 2 Error? Explain.

a) $n = 1137$ H_0: Proportion of Rep. = Proportion of Democrats

H_A: $p_{Rep} \neq p_{Dem}$

$p_R = \frac{264}{318} = 0.83$

$p_D = \frac{299}{369} = 0.81$

$p = 0.82$

$z = \frac{p_R - p_D}{\sqrt{(0.82)(0.18)\left(\frac{1}{318} + \frac{1}{369}\right)}} = 0.68$

$-1.96 < z < 1.96$ $\therefore$ Do not reject H_0

b) If we reject H_0 when it shouldn't be, Type 1. Whereas, Not rejecting H_0 when we should is Type 2.

6.34 Prenatal vitamins and Autism. Researchers studying the link between prenatal vitamin use and autism surveyed the mothers of a random sample of children aged 24 - 60 months with autism and conducted another separate random sample for children with typical development. The table below shows the number of mothers in each group who did and did not use prenatal vitamins during the three months before pregnancy (periconceptional period).[57]

		Autism		
		Autism	Typical development	Total
Periconceptional	No vitamin	111	70	181
prenatal vitamin	Vitamin	143	159	302
	Total	254	229	483

(a) State appropriate hypotheses to test for independence of use of prenatal vitamins during the three months before pregnancy and autism.

(b) Complete the hypothesis test and state an appropriate conclusion. (Reminder: Verify any necessary conditions for the test.)

(c) A New York Times article reporting on this study was titled "Prenatal Vitamins May Ward Off Autism". Do you find the title of this article to be appropriate? Explain your answer. Additionally, propose an alternative title.[58]

No R Questions this week.