Hypothesis testing for the population proportion

Hypothesis testing for the population proportion

- We are in sections 9.5, 9.6 of the textbook
- We're going to perform a hypothesis test on the proportion.
- We follow the same general process for hypothesis testing that we did for the mean.
- We use the z test because the standard deviation of the sampling distribution is known

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

- The z value is

$$z = (\hat{p} - p) / \left(\frac{\sqrt{p(1-p)}}{\sqrt{n}} \right)$$

1. Suppose that we have a sample with $n = 16$. The sample proportion is 80%. We want to test the hypothesis

$$H_0 : p = 85\% \qquad H_1 : p < 85$$

   (a) Find the value of z.

   (b) Find the p-value with a z table. Remember to use the inequality from the alternative hypothesis.

   (c) In this case, can we reject the null hypothesis?

2. A consumer group suspects that the proportion of households that have three cell phones is 30%. A cell phone company has reason to believe that the proportion is not 30%. Before they start a big advertising campaign, they conduct a hypothesis test. Their marketing group surveys 150 households and find that 43 of the households have three cell phones.

   (a) Write down the null hypothesis and alternative hypothesis.

   (b) Find the sample proportion $\hat{p}$.

   (c) Find the appropriate z value,

   $$z = (\hat{p} - p) / \left(\frac{\sqrt{p(1-p)}}{\sqrt{n}} \right)$$

   (d) Find the p-value with a z table.

   (e) If you had to say who was correct, what would your decision be?

3. The National Prisoner Statistics, United States, 1978 - 2017 study provides an enumeration of persons in state and federal prisons and collects data on key characteristics of the nation's prison population.

   From the NPS, we have the following data for male inmates in WV in 2017[1].

White	Black	Hispanic	AIAN	Asian	NHPI	Two or more	Total
5,388	822	18	6	5	1	46	6,286

   After Quiz 2, we briefly looked at why there was a steep increase in the number of US inmates – more are sent to prison and longer mandatory sentences – and the effect of private prisons. We also noted that there is a racial disparity in incarceration – black men are six times as likely to be incarcerated as white men (The Sentencing Project).

   Here we'll use hypothesis test on the proportion to examine the racial disparity issue in WV.

   (a) Compare the proportion of black men in WV prison in 2017 to the proportion of black men in all of WV in 2017, $p = 3.6\%$. Use a hypothesis test.

[1] AIAN is American Indian or Alaska Native; NHPI is Native Hawaiian or Pacific Islander; Hispanic is Hispanic or Latino; Note that White, Black, AIAN, Asian, NHPI, Two or more races also mean not of Hispanic origin.

(b) In 2019, the US Census Bureau estimated WV had a total of 33,963 black men and 854,475 white men.

i. Convert the incarceration numbers for black and white men to numbers out of 10,000 in WV.

ii. Convert the incarceration numbers for black and white men to probabilities that a randomly selected black (or white) man in WV is an inmate.

iii. Calculate the value requested.

For the WV data, in 2017 black men are _____ times as likely to be incarcerated as white men.