1. According to the manufacturer, 20% of plain M&M’s are orange, and 23% of peanut M&M’s are orange. Suppose you were able to take a simple random sample of 240 of each candy type. Let \( \hat{p}_1 \) = the sample proportion of plain M&M’s that are orange and \( \hat{p}_2 \) = the sample proportion of peanut M&M’s that are orange.

(a) Describe the sampling distribution of \( \hat{p}_1 - \hat{p}_2 \)

- **Shape:** NORMAL
- **Center:**
  \[ \hat{p}_1 - \hat{p}_2 = \hat{p}_1 - \hat{p}_2 = 0.20 - 0.23 = -0.03 \]
- **Spread:**
  \[ \sqrt{\frac{(0.20)(0.80)}{240} + \frac{(0.23)(0.77)}{240}} = 0.0375 \]

(b) What is the probability that you select a higher proportion of plain orange M&M’s than peanut orange M&M’s?

\[ P(\hat{p}_1 > \hat{p}_2) \]
\[ P(\hat{p}_1 - \hat{p}_2 > 0) \]

normal cdf (0.100000, -0.03, 0.0375) = 0.212 = 21.2%
2. A random sample of 415 potential voters was interviewed 3 weeks before the start of a state-wide campaign for governor. 223 of the 415 said they favored the new candidate over the incumbent. However, the new candidate made several unfortunate remarks one week before the election. Subsequently, a new random sample of 630 potential voters showed that 317 voters favored the new candidate. Do these data support the conclusion that there was a decrease in voter support for the new candidate after the unfortunate remarks were made? Give appropriate statistical evidence to support your answer.

State

\[ H_0: \ p_1 - p_2 = 0 \]
\[ H_a: \ p_1 - p_2 > 0 \]
\[ \alpha = .05 \]

\[ p_1 = \text{proportion of 1st set of voters} \]
\[ p_2 = \text{proportion of 2nd set of voters} \]

Before
\[ n_1 = 415 \]
\[ p_1 = \frac{223}{415} = .537 \]
\[ q_1 = .463 \]

After
\[ n_2 = 630 \]
\[ p_2 = \frac{317}{630} = .503 \]
\[ q_2 = .497 \]

Plan

Random

Normal

Ind

Do

\[ \hat{p} = \frac{223 + 317}{415 + 630} = \frac{540}{1045} = .51107 \]

\[ z = (\hat{p}_1 - \hat{p}_2) - 0 \]
\[ \sqrt{\frac{(.51107)(.48833)}{415} + \frac{(.51107)(.48833)}{630}} = 1.071 \]

\[ P(\hat{z} > 1.071) \]
\[ \text{normcdf}(1.071, 10.00000000, 0, 1) \]
\[ .141 \]

Conclude

Since .141 > .05 \rightarrow \text{fail to reject } H_0

We do not have enough evidence to conclude that the difference in the proportions of voters decreased after the unfortunate remarks were made.
3. The elderly fear crime more than younger people, even though they are less likely to be victims of crime. One study recruited separate random samples of 63 black women and 56 black men over the age of 65 from Atlantic City, New Jersey. Of the women, 27 said they “felt vulnerable” to crime; 46 of the men said this.

(a) Construct and interpret a 90% confidence interval for the difference in population proportions (men minus women).

\[
\begin{align*}
\text{men} & \quad \text{women} \\
n_1 &= 63 & n_2 &= 56 \\
p_1 &= \frac{46}{63} &= 0.73 & p_2 &= \frac{27}{56} &= 0.482 \\
\hat{q}_1 &= 0.27 & \hat{q}_2 &= 0.518 \\
\end{align*}
\]

\[
(z^* = 1.64) \\
(z^* = 1.64) \\
1.64 \sqrt{\frac{(0.73)(0.27)}{63} + \frac{(0.482)(0.518)}{56}}
\]

\[
0.248 \pm 0.1429
\]

\[
(0.105, 0.3909)
\]

* We are 90% confident that the interval 0.105 to 0.3909 contains the actual difference in the proportions of elderly men to women who feel vulnerable to crime.

(b) Does your interval from part (a) give convincing evidence of a difference between the population proportions? Explain.

Yes because the interval is above 0 which would indicate no difference. There is a clear difference between the population proportions.