1. A consumer agency wants to determine whether there is a difference between the proportions of the 2 leading automobile models that need major repairs (more than $500) within 2 years of their purchase. Of a random sample of 400 2-year owners of model 1, 53 reported that their cars need major repairs. For the random sample of 500 2-year model 2 owners this number was 78.

**a.** (2 points) Construct a two-sided 95% confidence interval for the proportion of model 1 cars needing major repairs minus the proportion of model 2 cars needing major repairs $\pi_1 - \pi_2$.

\[ n_1 = 400, P_1 = \frac{53}{400} = 0.1325 \]
\[ n_2 = 500, P_2 = \frac{78}{500} = 0.156 \]

\[ (P_1 - P_2) \pm z_{0.025} \sqrt{\frac{P_1(1-P_1)}{n_1} + \frac{P_2(1-P_2)}{n_2}} \]
\[ (0.1325 - 0.156) \pm 1.96 \sqrt{\frac{0.1325(0.8675)}{400} + \frac{0.156(0.844)}{500}} \]
\[ (-0.069, 0.022) \]

**b.** (1 point) If we’re interested in whether or not a discernible difference exists between the proportions needing major repairs, define the appropriate hypotheses in symbols and in words.

$H_0$: $\pi_1 - \pi_2 = 0$ proportions of the 2 types of cars needing major repairs within 2 years are the same
$H_A$: $\pi_1 - \pi_2 \neq 0$ proportions of the 2 types of cars needing major repairs within 2 years are different

**c.** (3 points) At the 5% error level, are the proportions needing major repairs within 2 years discernably different? Why or why not?

Since 0 falls within the confidence interval given in part (a), the proportions are not discernibly different at the 5% error level.

**d.** (1 point) If we’re now interested in knowing whether the percentage of model 2 cars that need major repairs in the first 2 years is discernibly higher than the percentage of model 1 cars that need major repairs, what are the hypotheses (use both symbols and words)?

$H_0$: $\pi_1 - \pi_2 = 0$ proportions of the 2 types of cars needing major repairs within 2 years are the same

$H_A$: $\pi_1 - \pi_2 > 0$ proportions of the 2 types of cars needing major repairs within 2 years are different
$H_A: \pi_1 - \pi_2 < 0$ proportion of model 2 cars needing major repairs within 2 years is higher than that of model 1 cars

e. (3 points) At the 5% error level, is the proportion of model 2 cars needing major repairs within 2 years discernibly higher than the percentage of model 1 cars that need major repairs?

Test statistic:

$$Z = \frac{P_1 - P_2 - 0}{\sqrt{\frac{P_1(1-P_1)}{n_1} + \frac{P_2(1-P_2)}{n_2}}} \approx -1.001$$

Since the critical value for a one-sided test with error level 5% is -1.64 (-1.65, -1.645 also accepted), we can’t reject the null hypothesis. The proportion of model 2 cars that need major repairs within 2 years is not discernibly higher than that of model 1 cars.

Can also do this using 1-sided 95% confidence interval:

$$\mu < (P_1 - P_2) + (1.64)\sqrt{\frac{P_1(1-P_1)}{n_1} + \frac{P_2(1-P_2)}{n_2}}$$

$$\mu < 0.015$$

Since 0 falls within the interval, we can’t reject the null hypothesis.