Technical Progress Report   STA304 Fall 2019

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We declare that this assignment is solely our own work, and is in accordance with the University of Toronto Code of Behaviour on Academic Matters.

This submission has been prepared using LATEX.

1   Introduction

Hypothesis: There are more cigarette smokers than e-cigarette smokers. Most of them smoke at a Designated Smoking Area (DSA).

Objective: Find number of cigarette smokers vs number of e-cigarette smokers by Simple Random Sampling (SRS).

$$y_i = \begin{cases} 1, & p: \text{ if individual smoked cigarette} \\ 0, & q: \text{ if individual smoked e-cigarette} \end{cases}$$

$$H_0 : p = q$$

where there is no difference between the proportion of students who smoke cigarettes and those who smoke e-cigarettes.

$$H_a : p > q$$

where the proportion of cigarette smokers is greater than the proportion of e-cigarette smokers.

We expect to see more cigarette smokers, but e-cigarettes are rising in popularity as of 2019, so it is possible that they have surpassed cigarettes in popularity now.

2   Appendix

Calculations: The method of data collection used is Simple Random Sampling. There are 14,544 students in University of Toronto Mississauga. Our population N represents the population of smokers at UTM. According to Statistics Canada, 19.2 percent of Canada's population aged 18-34 are smokers. Therefore, the population of smokers at UTM should be 19.2 percent of 14,544. $N = 0.192 * 14{,}544 = 2792$.

1. **Population Parameter:**

   $\hat{p} = \frac{1}{n} \sum_{i=1}^{N} y_i$

   $\Rightarrow \hat{p} = \frac{1}{126} \sum_{i=1}^{126} y_i$

   $\Rightarrow \hat{p} = \frac{1}{126} \sum_{i=1}^{126} 103$, as according to the data collected, 103 of 126 smokers

were smoking cigarettes

$\Rightarrow \hat{p} = 0.8175$, which is the estimate of the population proportion of cigarette smokers.

$\Rightarrow 1 - 0.8175 \approx 0.1825 = \hat{q}$, which the estimate of the population proportion of e-cigarette smokers.

2. **Variance of Point Estimate:**

   $\hat{V}(\hat{p}) = (1 - \frac{126}{2792})\frac{(0.1875)(0.1825)}{126-1}$

   $\Rightarrow \hat{V}(\hat{p}) = (0.95)(0.00119355)$
   $\Rightarrow \hat{V}(\hat{p}) = 0.0011338725$

3. **Bound B**

   $B = 2\sqrt{\hat{V}(\hat{p})}$

   $\Rightarrow B = 2\sqrt{0.0011338725}$
   $\Rightarrow B = 0.067346046$
   Margin of error for the study: 0.067346046

4. **95% Confidence Interval**
   $(\hat{p} - B, \hat{p} + B)$

   $\Rightarrow (0.8175 - 0.067346046, 0.8175 + 0.067346046)$

   $\Rightarrow (0.7502, 0.8848)$

   Interpretation of the Confidence Interval: We are 95% confident that the true proportion of people who smoke cigarettes is in between 0.750 and 0.884

5. **p-value**
   Test statistics for two proportions
   $Z = \frac{(\hat{p} - \hat{q}) - (p - q)}{\sqrt{(\frac{1}{n_1} + \frac{1}{n_2})}}$ where $n_1 = 103$ (sampled population of cigarette smokers), and $n_2 = 23$ (sampled population of e-cigarette smokers)

$\Rightarrow Z = \frac{(0.8175-0.1825)-0}{\sqrt{(\frac{1}{103}+\frac{1}{23})}}$

$\Rightarrow Z = \frac{0.635}{\sqrt{(0.0532)}}$

$\Rightarrow Z = 2.7531$

$p-value = P(Z > 2.7531) \approx 0$

Since p-value $< \alpha$=0.05 there is sufficient evidence to reject the null hypotheses. We can conclude by saying the proportion of cigarette smokers is most likely not equal to the proportion of e-cigarette smokers.

Final Report starts here
Our objective is to find the proportion of smokers that are cigarette smokers and the proportion of smokers that are e-cigarette smokers. We tested the hypothesis that there are more cigarette than e-cigarette smokers. In order to test this hypothesis, we assumed our hypothesis was false and attempted to contradict it.

We found that about 82% of smokers are cigarette smokers at University of Toronto Mississauga. We are 95% confident that the proportion of people who smoke cigarettes is in between 0.750 and 0.884, meaning that the e-cigarette smokers 12% to 25% are e-cigarette smokers.