
Project #4

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Course: *Sample Surveys (STAT 5180)* – Professor: *Jeffrey Holt*

Due date: *November 23rd, 2020*

1. Sampling Units and Sampling Design

Lowes has a total of 34 departments at lowes.com. There are 2 to 21 different categories within each department.

Our sampling design is:

1. First, take an SRSWR of 20 departments from the total of 34 departments with replacement.
2. Within each selected department, take a SRSWR of 5 categories.
3. Within each selected category, take an SRSWR of 2 products from the category. Record the price and inventory of the selected products.
4. After obtaining the sample, use Jackknife method to conduct resampling and estimate the variance.

During the sampling process, we encountered cases where the sampled department or category has no product available to pickup in Charlottesville store. We deleted those departments or categories from the population and resample the whole process again from the updated population, until all of the selected categories and departments have valid products. As a result, there are 26 departments shown at lowes.com that have valid stock available to pickup at Charlottesville store.¹

The sample selects 20 departments with replacement from the total of 26 valid departments. The sampled departments are: Animal & Pet Care, Flooring, Glues Tapes, Moulding & Millwork, Electrical, Plumbing, Bathroom, Hardware, Lawn & Garden, Heating & Cooling, Lawn & Garden, Automotive, Automotive, Lighting & Ceiling Fans, Hardware, Outdoors, Animal & Pet Care, Plumbing, Home Decor.

After obtaining the samples, to implement delete-1 Jackknife method, we deleted one psu (department in our problem) at a time and updated the weight for the rest observations. Then calculate the new estimator and further estimate the variance.

¹We spent 2 hours in total for sampling until all selected departments and categories have valid products in stock.

2. Computing Processing Results

We use following equation to calculate the weight of each sampled item:

$$w_i = \frac{1}{P(i \text{ is selected})} = \frac{1}{1 - P(i \text{ is not selected})}$$

Then we use the following equation to adjust the weight for jackknife method:

$$w_{i(j)} = \frac{n}{n-1} w_i$$

We use the following equations to estimate the total value and the variance:

$$\hat{t} = \sum_{i \in S} w_i y_i$$

$$\hat{t}_{(j)} = \sum_{i \in S} w_{i(j)} y_{i(j)}$$

$$\hat{V}_{JK}(\hat{t}) = \frac{n-1}{n} \sum_{j=1}^n (\hat{t}_{(j)} - \hat{t})^2$$

$$\hat{SE}_{JK}(\hat{t}) = \sqrt{\hat{V}_{JK}(\hat{t})}$$

By calculation, the estimate results are $\hat{t} = 43425888$, and $\hat{SE}_{JK}(\hat{t}) = 9300113$.

Then a 95% confidence interval of the total estimation is:

$$\hat{t} \pm 1.96 * \hat{SE}_{JK}(\hat{t}) = [25197668, 61654109]$$

After calculation, our estimation of the total stock value of Lowes Charlottesville store is 43425888, with a 95% confidence interval of [25197668, 61654109].

3. Assumptions Made

- We assume that there is no significant difference in price and inventory between products in different departments.
- Item prices and quantities will remain the same as we collected.