Proportion of University of Toronto Mississauga (UTM) STA304 Students Satisfied with the UTM Food Service

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COURSE PROJECT

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I. Introduction

Studies show that food and nutrition are an essential part of any student's success. Students who make this a priority in their daily lives are said to have better grades, cognitive performance and behavior.[1] In advocating for their students' success, it is important for universities to ensure they have satisfactory food services as these food services cater to the majority of meals that students consume. Many students, those living in residence and out of campus alike, rely on these food services to provide them with the nutrition they need to perform to the best of their abilities. Not only that, they need this to be provided to them in between their busy schedules which is why food options and quality are not enough to account for satisfaction, but the service and the environment in which the food is served must be taken into consideration as well. In addition to this, entering university is said to be highly correlated with students being more liberated in their dietary preferences.[2] Among the dietary preferences that have been on the rise are veganism, vegetarianism, and the consumption of strictly gluten-free or non-dairy food. As eating habits and preferences have grown increasingly diverse among students, there is a demand for food places on campus which takes these habits and preferences into consideration.

In this study, we survey the satisfaction level of STA304 students with regards to the university's food service. UTM food services include all food served at UTM, from the food courts in Davis, Deerfield, IB, CCIT to the stand-alone stores like Starbucks, Tim Hortons, Second Cup. The results were then analyzed by first separating the student responses into their different dietary preferences namely, no dietary preference, vegetarian, halal, vegan, gluten-free, and non-dairy. By doing this, we will be able to infer whether certain preferences are more accommodated than others and make appropriate suggestions for improvement. Through the survey, we will also be able to better understand the different variables that affect how UTM STA304 students think about the university's food service. This can help the university refine their food services across campus and build a more successful and inclusive community.

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[1] Centers for Disease Control and Prevention. (2014). *Health and Academic Achievement* [Brochure]. Atlanta, Georgia: Author. Retrieved November 24, 2020, from https://www.cdc.gov/healthyyouth/health_and_academics/pdf/health-academic-achievement.pdf

[2] Plotnikoff, R. C., Costigan, S. A., Williams, R. L., Hutchesson, M. J., Kennedy, S. G., Robards, S. L., Allen, J., Collins, C. E., Callister, R., & Germov, J. (2015). Effectiveness of interventions targeting physical activity, nutrition and healthy weight for university and college students: a systematic review and meta-analysis. *The International Journal of Behavioral Nutrition and Physical Activity*, *12*. https://doi.org/10.1186/s12966-015-0203-7

II. Description of Variables in the Data

A study shows that, to university students, "the greatest determinants of food choice were taste, value, convenience, and cost."[3] Because of this, a survey was put together that tested the following variables with regards to satisfaction: dietary preferences, food options, food pricing, food quality, service of staff, cleanliness of the area, convenience of location, overall experience, and likelihood of visiting again. Knowing their dietary preference will tell us whether certain dietary preferences are more accommodated than others and whether this affects the satisfaction level of STA304 students. Satisfaction regarding the food options available will tell us whether each dietary preference has a sufficient number of options available for students to consume and whether the students deem these options to be ample for their nutrition needs. Satisfaction regarding the pricing of food will allow us to infer whether students are satisfied or dissatisfied by the pricing of food. Satisfaction regarding the quality of food served will tell us whether the food served has been prepared excellently or subpar. This will be able to shed light on the nutritional value of the food to the students as well. Satisfaction regarding the service of the staff will allow us to determine whether the efficiency of service allows students to purchase the food they need and still make it on time to their busy schedules. Satisfaction regarding the cleanliness of the area will let us decipher whether the conditions in which the food was made and the area it was prepared in affects students' satisfaction. Satisfaction regarding the convenience of the location of food services will again shed light on another aspect that may affect the busy schedules of university students. Satisfaction regarding the overall experience will give us a rough estimate as to whether students lean more toward satisfaction and dissatisfaction. Lastly, the likelihood of visiting again will tell us whether these variables are strong enough to elicit a response of visiting again if they were pleased or not visiting again because they were totally disappointed. Respondents were asked to score all these variables from a range of 1, being extremely dissatisfied or highly unlikely, to 5, being extremely satisfied or highly likely. All together, these will be able to paint us a picture of what aspects of the food service are satisfactory and what still needs to be improved in order to support the success of students.

The survey was sent out to all STA304 students, in both lecture 1 and lecture 2. An incentive was given to encourage participation that would give us more accurate and representative results however, due to the online nature of this semester's classes, our channels of communication were limited. As a result, the sample was limited, as well, to those who desired to answer the survey.

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[3] Ryan Tam, Barbara Yassa, Helen Parker, Helen O'Connor, Margaret Allman-Farinelli. (2017). University students' on-campus food purchasing behaviors, preferences, and opinions on food availability. *Nutrition*, Volume 37, Pages 7-13. ISSN 0899-9007, https://doi.org/10.1016/j.nut.2016.07.007.

In order to ensure the internal consistency and reliability of the variables assessed in the questionnaire, we used Cronbach's alpha on the "no dietary preference" sample, the largest strata sample collected. A good rule of thumb to prove consistency is to have alpha greater than or equal to 0.7.[4] In our calculation, we see that alpha is 0.779 which proves the consistency and reliability of the variables in the questionnaire. The results of the survey were then computed and analyzed. We hypothesize that a proportion of 50% ($p=0.5$) will not allow us to conclude whether students are satisfied with the service or not, while a proportion not equal to 50% ($p\neq0.5$) will allow us to determine whether students lean more toward satisfaction or dissatisfaction.

III. Interpretation of the Results

Though we had hoped to collect more data so as to have more significant results, we were only able to collect responses from a sample of 40 students. In order to analyse the results more efficiently, responses to the variables in the range of 1 to 2 were grouped together as this told us that the student leaned more toward dissatisfaction, responses in the range of 4 to 5 were grouped together as this signaled that the student leaned more toward satisfaction, and responses that were neutral (3) were disregarded as this could not tell us whether the student leaned more toward satisfaction or dissatisfaction. The results are summarized below.

Item	Frequency	Percentage
3	***Satisfaction regarding OPTIONS AVAILABLE***	
	Satisfied	40
	Neutral	42.5
	Dissatisfied	17.5
4	***Satisfaction regarding PRICING***	
	Satisfied	15
	Neutral	35
	Dissatisfied	50
5	***Satisfaction regarding QUALITY OF FOOD***	
	Satisfied	20
	Neutral	50
	Dissatisfied	30
6	***Satisfaction regarding SERVICE***	

[4] Goforth, C. (2015, November 16). Using and Interpreting Cronbach's Alpha. Retrieved November 24, 2020, from https://data.library.virginia.edu/using-and-interpreting-cronbachs-alpha/

	Satisfied	47.5
	Neutral	32.5
	Dissatisfied	20
7	***Satisfaction regarding CLEANLINESS***	
	Satisfied	52.5
	Neutral	37.5
	Dissatisfied	10
8	***Satisfaction regarding CONVENIENCE OF LOCATION***	
	Satisfied	65
	Neutral	27.5
	Dissatisfied	7.5
9	***Satisfaction regarding OVERALL EXPERIENCE***	
	Satisfied	45
	Neutral	40
	Dissatisfied	15
10	***Likelihood of BUYING FROM THE SERVICE AGAIN***	
	Likely	65
	Neutral	22.5
	Unlikely	12.5

As we can see from the table, out of 40 responses, only 45% are satisfied with the overall experience. This means that the majority of the sample lean more toward dissatisfaction. Among the areas where the majority of students lean more toward satisfaction are the cleanliness of the area at 52.5% and the convenience of the location at 65%. From this we can infer that the cleanliness of the area and the convenience of the location did not contribute to the dissatisfaction of the food service. On the other hand, we see from the results that only 40% of students are satisfied with regards to the food options available, only 15% are satisfied with regards to pricing, 20% are satisfied with regards to quality of food, and 47.5% are satisfied with the service of the staff. We can interpret these as areas that can be improved. Pricing is something that can be adjusted to further accommodate students' financial wellbeing while satisfaction regarding food options available and quality of food is something that can be investigated further. Though we know from the survey that it is something that should be improved, when it comes to options and quality, the specificities of the improvements could be further analyzed – is the dissatisfaction due to a student's dietary preference or nutritional needs? We can also interpret that the service of the staff can be slightly improved to better accommodate the students. A faster and more efficient process of purchasing may better allow a student to buy

and consume their meal in the limited time they have in their schedules. An interesting result from the survey is the fact that while the majority lean more toward dissatisfaction, still 65% of students would buy from the service again. From this, we can interpret that the dissatisfaction in some variables were not strong enough to stop students from buying from the food service again. However, improvements should still be made to support the success of students.

IV. Conclusion

In conclusion, the majority of students lean more towards dissatisfaction when it comes to the UTM food service. A few notable areas that should be improved are the food options available, pricing of food, quality of food, and the service of the staff. This is important to know because through it, we are able to shed light on areas affecting the food and nutrition students receive. As we know, this is an essential part of student success because it aids students in performing at their best. Through this study, we are also able to identify certain preferences that should be further accommodated in order to promote a more inclusive community.

V. Limitations

There are certainly limitations that exist in this report, one of the most glaring being the existence of a non-response bias. In hopes of minimizing this impact, a raffle reward was set where anyone who took part in the survey would gain a chance of winning one of five gift cards but still, majority of students who are taking STA304 in the 2020 Fall semester did not respond to our online questionnaire due to the limited channels of communication imposed on us by the online nature of classes. This resulted in an inadequate amount of surveying feedback. This matter will cause the results to be somehow deviated compared to the real proportion of STA304 students who are satisfied with the food service at UTM. In our calculation, the theoretical sample that we need for accurate results would be 67 people however, from the data we received, there were only 40 responses. We accounted for this deviation by allowing for a greater margin of error on the bound.

Another limitation in our study is the fact that our sample was limited to the STA304H5 F class only and we cannot conclude whether this is representative of the whole UTM student body. In making changes and suggestions to the UTM food service, it is important that the sentiments expressed by the STA304 students reflect those of the students as a whole because these changes will affect all of them therefore, results and inferences may be more accurate if a study is done, in the future, that accounts for a good representation of the whole UTM community.

References

Centers for Disease Control and Prevention. (2014). *Health and Academic Achievement* [Brochure]. Atlanta, Georgia: Author. Retrieved November 24, 2020, from https://www.cdc.gov/healthyyouth/health_and_academics/pdf/health-academic-achievement.pdf

Goforth, C. (2015, November 16). Using and Interpreting Cronbach's Alpha. Retrieved November 24, 2020, from https://data.library.virginia.edu/using-and-interpreting-cronbachs-alpha/

Plotnikoff, R. C., Costigan, S. A., Williams, R. L., Hutchesson, M. J., Kennedy, S. G., Robards, S. L., Allen, J., Collins, C. E., Callister, R., & Germov, J. (2015). Effectiveness of interventions targeting physical activity, nutrition and healthy weight for university and college students: a systematic review and meta-analysis. *The International Journal of Behavioral Nutrition and Physical Activity*, *12*. https://doi.org/10.1186/s12966-015-0203-7

Ryan Tam, Barbara Yassa, Helen Parker, Helen O'Connor, Margaret Allman-Farinelli. (2017). University students' on-campus food purchasing behaviors, preferences, and opinions on food availability. *Nutrition*, Volume 37, Pages 7-13. ISSN 0899-9007, https://doi.org/10.1016/j.nut.2016.07.007.

Appendix

Appendix A: Questionnaire

UTM food services include all food served at UTM, from the food courts in Davis, Deerfield, IB, CCIT to the stand-alone stores like Starbucks, Tim Hortons, Second Cup.

1. What is your **dietary preference**?
    a. Gluten-free
    b. Kosher
    c. Halal
    d. Vegan
    e. Vegetarian
    f. No dietary preference
    g. Other, please specify:

2. Have you ever **ordered food from the UTM food service**?
    a. Yes
    b. No

3. Based on your dietary preference, are you satisfied with the **options** available in the food service?
    a. Extremely Satisfied
    b. Satisfied
    c. Neutral
    d. Dissatisfied
    e. Extremely Dissatisfied

4. Based on your dietary preference, are you satisfied with the **pricing** of the food available in the food service?
    a. Extremely satisfied
    b. Satisfied
    c. Neutral
    d. Dissatisfied
    e. Extremely dissatisfied

5. How satisfied are you with the **quality of the food** you purchased?
    a. Extremely satisfied
    b. Satisfied
    c. Neutral

d. Dissatisfied
e. Extremely dissatisfied

6. How satisfied are you with the **service of the staff** in the UTM food service?
a. Extremely satisfied
b. Satisfied
c. Neutral
d. Dissatisfied
e. Extremely dissatisfied

7. How satisfied are you with the **cleanliness** of UTM's food services ?
a. Extremely satisfied
b. Satisfied
c. Neutral
d. Dissatisfied
e. Extremely dissatisfied

8. How satisfied are you with the **convenience of the location of** UTM's food services ?
a. Extremely satisfied
b. Satisfied
c. Neutral
d. Dissatisfied
e. Extremely dissatisfied

9. How would you rate your **overall experience** with the food service?
a. Extremely satisfactory
b. Satisfactory
c. Neutral
d. Unsatisfied
e. Extremely unsatisfactory

10. How likely are you to buy from the food service again?
a. Very likely
b. Likely
c. Neutral
d. Unlikely
e. Very unlikely

Appendix B: Technical Report

The **objective** of our analysis is to determine the proportion of UTM STA304 students satisfied with the UTM Food Service. With the results of this study, we will be able to identify what areas could be improved to further accommodate the food preferences of UTM students.

We **hypothesize** that a proportion of 0.5 ($p=0.5$) will not allow us to conclude whether students are satisfied with the service or not, while a proportion not equal to 0.5 ($p\neq0.5$) will allow us to determine whether students lean more toward satisfaction or dissatisfaction.

In order to assess satisfaction, a questionnaire was sent out to UTM STA304 students that examines the following **variables**: (1) dietary preference - to tell us whether certain dietary preferences are more accommodated than others and whether this affects the satisfaction of STA304 students, (2) satisfaction regarding the food options available, (3) satisfaction regarding the pricing of food, (4) satisfaction regarding the quality of food served, (5) satisfaction regarding the service of the staff, (6) satisfaction regarding the cleanliness of the area, (7) satisfaction regarding the convenience of the location of food services, (8) satisfaction regarding the overall experience, and (9) the likelihood of visiting again.

Using the responses to the dietary preference question, we separated the sample into **stratas** (namely, no-dietary preference, vegetarian, halal, vegan, gluten-free, non-dairy) as we believe that these will make the sample homogeneous. Their dietary preference could affect their level of satisfaction if one certain group is more accommodated than the other. With the sample size of 40 responses collected, we calculated the allocation fraction and stratum sample sizes, respectively, as follows: 0.7805 and 31 with no dietary preference, 0.07647 and 3 vegetarians, 0.08449 and 3 halal, 0.05854 and 2 vegans, 0 and 0 for both gluten-free and non-dairy. These calculations are found in Appendix B.

We used **Cronbach's alpha** on the "no dietary preference" sample in order to prove the internal consistency of the variables surveyed in the questionnaire. A good rule of thumb to prove consistency is to have alpha greater than or equal to 0.7. In our calculation, we see that alpha is 0.779 which proves the consistency and reliability of the variables in the questionnaire. This calculation can be found in Appendix D.

Out of the sample size of 40 responses collected, the **results** tell us that we can estimate the proportion of satisfied students to be 0.46574 with a variance of 0.0058 as seen in Appendix B. With a sample size of 40, we also calculated the bound on the error to be 0.1380. The hypothesis test, seen in Appendix A, gives us $p=0.45$ which tells us that the result we calculated is significant and is considered valid and repeatable. In calculating the proportion of students

satisfied and dissatisfied with certain variables, the results also tell us that students are overwhelmingly dissatisfied with the pricing of food as seen in Appendix C.

Therefore, we can **conclude** that students lean more toward dissatisfaction with regards to the UTM food service. There are certainly aspects of the food service that can be improved, such as pricing, to further accommodate the preferences of students.

Technical Report - Attachment 1

Hypothesis Testing

Satisfaction regarding the food options available –

```
> prop.test(16, 40, p = 0.5)

        1-sample proportions test with continuity correction

data:  16 out of 40, null probability 0.5
X-squared = 1.225, df = 1, p-value = 0.2684
alternative hypothesis: true p is not equal to 0.5
95 percent confidence interval:
 0.2528112 0.5660892
sample estimates:
  p
0.4
```

Satisfaction regarding the pricing of food –

```
> prop.test(6, 40, p = 0.5)

        1-sample proportions test with continuity correction

data:  6 out of 40, null probability 0.5
X-squared = 18.225, df = 1, p-value = 1.963e-05
alternative hypothesis: true p is not equal to 0.5
95 percent confidence interval:
 0.06249087 0.30520616
sample estimates:
   p
0.15
```

Satisfaction regarding the quality of food served –

```
> prop.test(8, 40, p = 0.5)

        1-sample proportions test with continuity correction

data:  8 out of 40, null probability 0.5
X-squared = 13.225, df = 1, p-value = 0.0002762
alternative hypothesis: true p is not equal to 0.5
95 percent confidence interval:
 0.09614522 0.36137437
sample estimates:
  p
0.2
```

Satisfaction regarding the service of the staff –

```
> prop.test(19, 40, p = 0.5)

        1-sample proportions test with continuity correction

data:  19 out of 40, null probability 0.5
X-squared = 0.025, df = 1, p-value = 0.8744
alternative hypothesis: true p is not equal to 0.5
95 percent confidence interval:
 0.3181614 0.6365578
sample estimates:
    p
0.475
```

Satisfaction regarding the cleanliness of the area –

```
> prop.test(21, 40, p = 0.5)

        1-sample proportions test with continuity correction

data:  21 out of 40, null probability 0.5
X-squared = 0.025, df = 1, p-value = 0.8744
alternative hypothesis: true p is not equal to 0.5
95 percent confidence interval:
 0.3634422 0.6818386
sample estimates:
    p
0.525
```

Satisfaction regarding the convenience of the location of food services –

```
> prop.test(26, 40, p=0.5)

        1-sample proportions test with continuity correction

data:  26 out of 40, null probability 0.5
X-squared = 3.025, df = 1, p-value = 0.08199
alternative hypothesis: true p is not equal to 0.5
95 percent confidence interval:
 0.4826446 0.7889540
sample estimates:
   p
0.65
```

Satisfaction regarding the overall experience –

```
> prop.test(18, 40, p=0.5)

        1-sample proportions test with continuity correction

data:  18 out of 40, null probability 0.5
X-squared = 0.225, df = 1, p-value = 0.6353
alternative hypothesis: true p is not equal to 0.5
95 percent confidence interval:
 0.2960304 0.6134103
sample estimates:
   p
0.45
```

Likelihood of visiting again –

```
> prop.test(26, 40, p=0.5)

        1-sample proportions test with continuity correction

data:  26 out of 40, null probability 0.5
X-squared = 3.025, df = 1, p-value = 0.08199
alternative hypothesis: true p is not equal to 0.5
95 percent confidence interval:
 0.4826446 0.7889540
sample estimates:
   p
0.65
```

Technical Report - Attachment 2

Formulas, Code, Computation

$$\widehat{p_{st}} = \frac{1}{N}\sum_{i=1}^{L} N_i\widehat{p_i} = \frac{1}{270}[100 + 6.25 + 7.5 + 12 + 0 + 0] = 0.46574$$

Estimated Proportion (p_hat)

In [109]:
```
# Calculation of the estimated proportion

N = 270
Ni = [6, 15, 200, 4, 20, 25]
stratums = ['non-dairy', 'Vegan', 'No dietary preference', 'Gluten-free', 'Vegetarian', 'Halal']
info = []
sum = 0

for stratas in stratums:
    new_table = df[df['DIETARY PREFERENCE'] == stratas]
    satisfactory = new_table[df['Satisfaction regarding OVERALL EXPERIENCE'] > 3]
    result = satisfactory.shape[0]/new_table.shape[0]
    info.append((stratas, Ni[stratums.index(stratas)], result))

for tupl in info:
    sum += tupl[1] * tupl[2]

estimate_proportion = sum/N
print("The estimated proportion is:", round(estimate_proportion, 5))
```

```
The estimated proportion is: 0.46574
```

$$\widehat{Var(\widehat{p_{st}})} = \frac{1}{N^2}\sum_{i=1}^{L} N_i^2(1 - \frac{n_i}{N_i})(\frac{\widehat{p_i}\widehat{q_i}}{n_i - 1})$$

Estimated Variance (p_hat)

In [116]:
```
# Calculation of Numerator
sum = 0
for index, tupl in enumerate(info):
    Ni_squared = tupl[1]**2
    num = (1 - ((strata_size[index][1])/Ni[index]))
    num2 = (tupl[2] * (1 - tupl[2]))/(strata_size[index][1] - 1)
    sum += (Ni_squared * num * num2)

variance = sum/N**2
print("The Estimated Variance of p_hat is", round(variance, 5))
```

```
The Estimated Variance of p_hat is 0.0058
```

With 40 responses collected, we used the formula for n to calculate B which gives B=0.1380.

$$n = \frac{(\sum_{i=1}^{L} N_i\sqrt{\widehat{p_i}\widehat{q_i}})^2}{\frac{N^2B^2}{4} + \sum_{i=1}^{L} N_i\widehat{p_i}\widehat{q_i}}$$

$$40 = \frac{(\sum_{i=1}^{6} N_i\sqrt{p_iq_i})^2}{\frac{270^2B^2}{4} + \sum_{i=1}^{6} N_ip_iq_i} \quad 40 = \frac{(128.1233)^2}{18225B^2 + 63.2375} \quad 40(18225B^2 + 63.2375) = 16415.58$$

$$729000B^2 + 2529.5 = 16415.58 \quad 729000B^2 = 13886.08 \quad B^2 = 0.01904812$$

$$B = 0.1380$$

Sample Size

In [114]:
```
# Calculation of the numerator

sum = 0
bound = 0.1380
for index, tupl in enumerate(info):
    if tupl[2] != float(0):
        sum += (tupl[1]**2 * tupl[2] * (1 - tupl[2]))/ai[index]

# Calculation of the denominator

sum2 = 0
for tupl in info:
    if tupl[2] != float(0):
        sum2 += tupl[1] * tupl[2] * (1- tupl[2])
sum2 += N**2 * (bound**2/4)

n = sum/sum2
print("The Sample Size, n, is ", round(n,0))
```

```
The Sample Size, n, is  40.0
```

$$a_i = \frac{N_i \sqrt{\widehat{p_i}\widehat{q_i}}}{\sum_{i=1}^{L} N_i \sqrt{\widehat{p_i}\widehat{q_i}}}$$

Allocation Fractions

In [110]:
```
# Calculation of allocation fraction

   # summation of allocation fractions

sum = 0
for tupl in info:
    sum += tupl[1] * (tupl[2] * (1 - tupl[2]))**0.5

   # Individual Allocation Fractions

non_dairy_ai = (info[0][1] * (info[0][2] * (1 - info[0][2]))**0.5)/sum
vegan_ai = (info[1][1] * (info[1][2] * (1 - info[1][2]))**0.5)/sum
no_dietary_ai = (info[2][1] * (info[2][2] * (1 - info[2][2]))**0.5)/sum
glutenfree_ai = (info[3][1] * (info[3][2] * (1 - info[3][2]))**0.5)/sum
vegetarian_ai = (info[4][1] * (info[4][2] * (1 - info[4][2]))**0.5)/sum
halal_ai = (info[5][1] * (info[5][2] * (1 - info[5][2]))**0.5)/sum
ai = [non_dairy_ai, vegan_ai, no_dietary_ai, glutenfree_ai, vegetarian_ai, halal_ai]

print("Individual Allocation fractions are: ")
print()
print("The Allocation fraction for " + stratums[0], round(non_dairy_ai, 5))
print("The Allocation fraction for " + stratums[1], round(vegan_ai, 5))
print("The Allocation fraction for " + stratums[2], round(no_dietary_ai, 5))
print("The Allocation fraction for " + stratums[3], round(glutenfree_ai, 5))
print("The Allocation fraction for " + stratums[4], round(vegetarian_ai, 5))
print("The Allocation fraction for " + stratums[5], round(halal_ai, 5))
```

```
Individual Allocation fractions are:

The Allocation fraction for non-dairy 0.0
The Allocation fraction for Vegan 0.05854
The Allocation fraction for No dietary preference 0.7805
The Allocation fraction for Gluten-free 0.0
The Allocation fraction for Vegetarian 0.07647
The Allocation fraction for Halal 0.08449
```

$$n_i = \frac{nN_i\sqrt{\widehat{p}_i\widehat{q}_i}}{\sum_{i=1}^{L} N_i\sqrt{\widehat{p}_i\widehat{q}_i}}$$

Stratum Sample Sizes

In [115]:
```
strata_size = []
for index, allocation in enumerate(ai):
    ni = n * allocation
    strata_size.append((stratums[index], round(ni, 0) ))
    print("The stratum size of " + stratums[index], round(ni, 0))
```

```
The stratum size of non-dairy 0.0
The stratum size of Vegan 2.0
The stratum size of No dietary preference 31.0
The stratum size of Gluten-free 0.0
The stratum size of Vegetarian 3.0
The stratum size of Halal 3.0
```

Technical Report - Attachment 3

Frequency Table for each Item in the Survey per Stratum

No dietary preference –

Question		Frequency	Percentage
Options available	Satisfied	12	0.4615
	Dissatisfied	3	0.1154
	Neutral	11	0.4231
Pricing	Satisfied	5	0.1923
	Dissatisfied	12	0.4615
	Neutral	9	0.3462
Quality of food	Satisfied	4	0.1538
	Dissatisfied	7	0.2692
	Neutral	15	0.5769
Service	Satisfied	13	0.5
	Dissatisfied	2	0.0769
	Neutral	11	0.4231
Cleanliness	Satisfied	13	0.5
	Dissatisfied	2	0.0769
	Neutral	11	0.4231
Convenience of location	Satisfied	16	0.6154
	Dissatisfied	9	0.3462
	Neutral	1	0.0385
Overall experience	Satisfied	13	0.5
	Dissatisfied	4	0.1538
	Neutral	9	0.3462

Likely to buy again	Yes	16	0.6154
	No	4	0.1538
	Neutral	6	0.2308

Vegetarian –

Question		Frequency	Percentage
Options available	Satisfied	2	0.4
	Dissatisfied	2	0.4
	Neutral	1	0.2
Pricing	Satisfied	0	0
	Dissatisfied	4	0.8
	Neutral	1	0.2
Quality of food	Satisfied	2	0.4
	Dissatisfied	2	0.4
	Neutral	1	0.2
Service	Satisfied	2	0.4
	Dissatisfied	2	0.4
	Neutral	1	0.2
Cleanliness	Satisfied	3	0.6
	Dissatisfied	1	0.2

	Neutral	1	0.2
Convenience of location	Satisfied	3	0.6
	Dissatisfied	1	0.2
	Neutral	1	0.2
Overall experience	Satisfied	3	0.6
	Dissatisfied	0	0
	Neutral	2	0.4
Likely to buy again	Yes	4	0.8
	No	0	0
	Neutral	1	0.2

Halal –

Question		Frequency	Percentage
Options available	Satisfied	1	0.25
	Dissatisfied	1	0.25
	Neutral	2	0.5
Pricing	Satisfied	0	0
	Dissatisfied	2	0.5
	Neutral	2	0.5
Quality of food	Satisfied	1	0.25

	Dissatisfied	2	0.5
	Neutral	1	0.25
Service	Satisfied	3	0.75
	Dissatisfied	1	0.25
	Neutral	0	0
Cleanliness	Satisfied	3	0.75
	Dissatisfied	0	0
	Neutral	1	0.25
Convenience of location	Satisfied	4	1
	Dissatisfied	0	0
	Neutral	0	0
Overall experience	Satisfied	1	0.25
	Dissatisfied	1	0.25
	Neutral	2	0.5
Likely to buy again	Yes	3	0.75
	No	0	0
	Neutral	1	0.25

Vegan –

Question		Frequency	Percentage
Options available	Satisfied	1	0.5
	Dissatisfied	1	0.5
	Neutral	0	0
Pricing	Satisfied	1	0.5
	Dissatisfied	1	0.5
	Neutral	0	0
Quality of food	Satisfied	0	0
	Dissatisfied	1	0.5
	Neutral	1	0.5
Service	Satisfied	0	0
	Dissatisfied	1	0.5
	Neutral	1	0.5
Cleanliness	Satisfied	1	0.5
	Dissatisfied	0	0
	Neutral	1	0.5
Convenience of location	Satisfied	0	0
	Dissatisfied	1	0.5
	Neutral	1	0.5
Overall experience	Satisfied	1	0.5
	Dissatisfied	1	0.5
	Neutral	0	0
Likely to buy again	Yes	1	0.5
	No	0	0
	Neutral	1	0.5

Gluten-free –

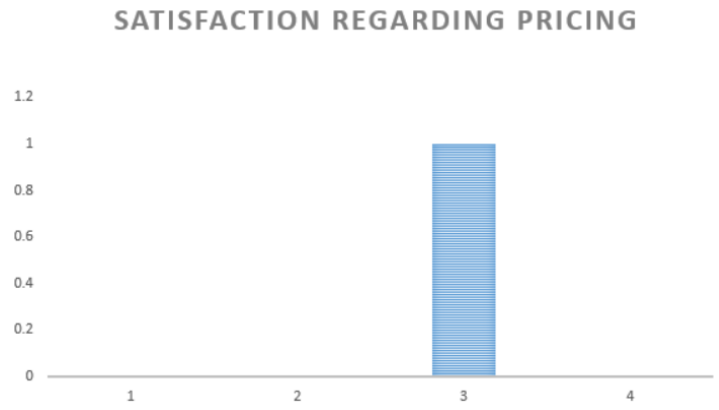
Question		Frequency	Percentage
Options available	Satisfied	0	0
	Dissatisfied	0	0
	Neutral	2	1
Pricing	Satisfied	0	0
	Dissatisfied	1	0.5
	Neutral	1	0.5
Quality of food	Satisfied	1	0.5
	Dissatisfied	0	0
	Neutral	1	0.5
Service	Satisfied	1	0.5
	Dissatisfied	1	0.5
	Neutral	0	0
Cleanliness	Satisfied	1	0.5
	Dissatisfied	0	0
	Neutral	1	0.5
Convenience of location	Satisfied	2	1
	Dissatisfied	0	0
	Neutral	0	0

Overall experience	Satisfied	0	0
	Dissatisfied	0	0
	Neutral	2	1
Likely to buy again	Yes	1	0.5
	No	0	0
	Neutral	1	0.5

Non-dairy –

Question		Frequency	Percentage
Options available	Satisfied	0	0
	Dissatisfied	0	0
	Neutral	1	1
Pricing	Satisfied	0	0
	Dissatisfied	0	0
	Neutral	1	1
Quality of food	Satisfied	0	0
	Dissatisfied	0	0
	Neutral	1	1
Service	Satisfied	0	0
	Dissatisfied	1	1

	Neutral	0	0
Cleanliness	Satisfied	0	0
	Dissatisfied	1	1
	Neutral	0	0
Convenience of location	Satisfied	1	1
	Dissatisfied	0	0
	Neutral	0	0
Overall experience	Satisfied	0	0
	Dissatisfied	0	0
	Neutral	1	1
Likely to buy again	Yes	1	1
	No	0	0
	Neutral	0	0



Total proportions –

In [19]:
```
# Question 1 Proportions
df['DIETARY PREFERENCE'].value_counts(normalize = True)
```

Out[19]:
```
No dietary preference    0.650
Vegetarian               0.125
Halal                    0.100
Vegan                    0.050
Gluten-free              0.050
non-dairy                0.025
Name: DIETARY PREFERENCE, dtype: float64
```

In [20]:
```
# Question 2 Proportions
df['Have you ever ordered food from the UTM food service?'].value_counts(normalize = True)
```

Out[20]:
```
Yes    1.0
Name: Have you ever ordered food from the UTM food service?, dtype: float64
```

In [21]:
```
# Question 3 Proportions
df['Satisfaction regarding OPTIONS AVAILABLE'].value_counts(normalize = True)
```

Out[21]:
```
Neutral                  0.425
Satisfied                0.375
Dissatisfied             0.125
Extremely dissatisfied   0.050
Extremely satisfied      0.025
Name: Satisfaction regarding OPTIONS AVAILABLE, dtype: float64
```

In [22]:
```
# Question 4 Proportions
df['Satisfaction regarding PRICING'].value_counts(normalize = True)
```

Out[22]:
```
Neutral                  0.35
Dissatisfied             0.30
Extremely dissatisfied   0.20
Satisfied                0.15
Name: Satisfaction regarding PRICING, dtype: float64
```

In [23]:
```
# Question 5 Proportions
df['Satisfaction regarding QUALITY OF FOOD'].value_counts(normalize = True)
```

Out[23]:
```
Neutral                  0.50
Dissatisfied             0.25
Satisfied                0.20
Extremely dissatisfied   0.05
Name: Satisfaction regarding QUALITY OF FOOD, dtype: float64
```

In [24]:
```
# Question 6 Proportions
df['Satisfaction regarding SERVICE'].value_counts(normalize = True)
```

Out[24]:
```
Satisfied                0.400
Neutral                  0.325
Dissatisfied             0.125
Extremely dissatisfied   0.075
Extremely satisfied      0.075
Name: Satisfaction regarding SERVICE, dtype: float64
```

In [25]:
```
# Question 7 Proportions
df['Satisfaction regarding CLEANLINESS'].value_counts(normalize = True)
```

Out[25]:
```
Satisfied              0.475
Neutral                0.375
Dissatisfied           0.100
Extremely satisfied    0.050
Name: Satisfaction regarding CLEANLINESS, dtype: float64
```

In [27]:
```
# Question 8 Proportions
df['Satisfaction regarding CONVENIENCE OF LOCATION'].value_counts(normalize = True)
```

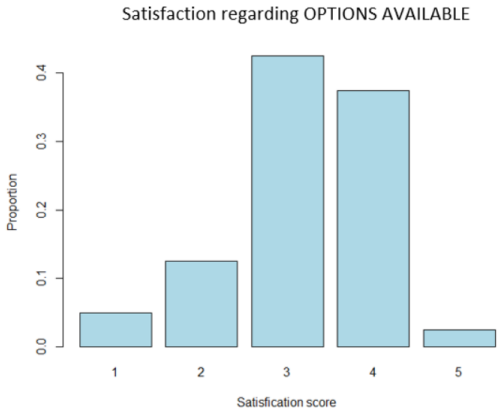
Out[27]:
```
Satisfied              0.625
Neutral                0.275
Dissatisfied           0.075
Extremely satisfied    0.025
Name: Satisfaction regarding CONVENIENCE OF LOCATION, dtype: float64
```

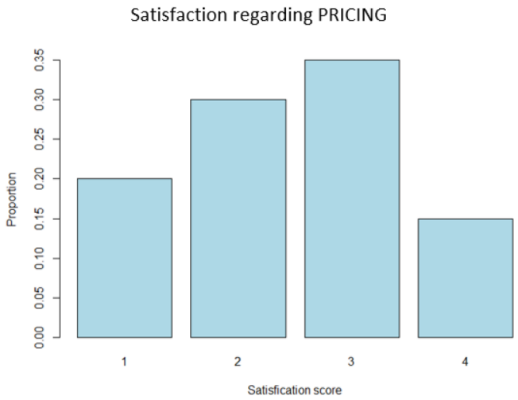
In [28]:
```
# Question 9 Proportions
df['Satisfaction regarding OVERALL EXPERIENCE'].value_counts(normalize = True)
```

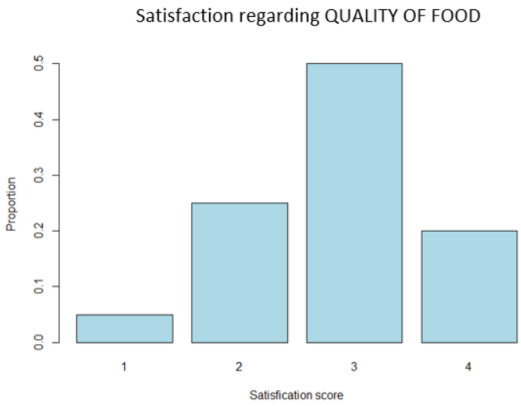
Out[28]:
```
Satisfactory                0.400
Neutral                     0.400
Dissatisfactory             0.125
Extremely satisfactory      0.050
Extremely dissatisfactory   0.025
Name: Satisfaction regarding OVERALL EXPERIENCE, dtype: float64
```

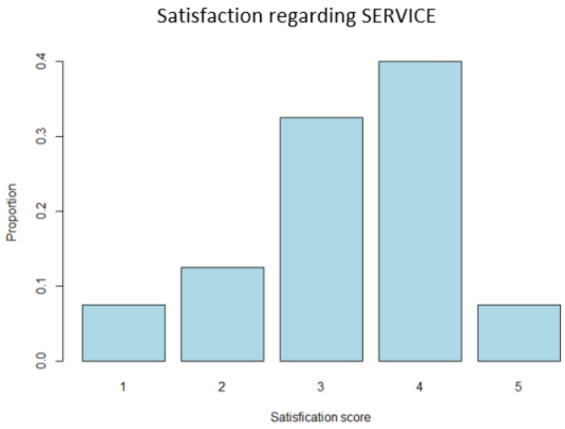
In [29]:
```
# Question 10 Proportions
df['Likelihood of BUYING FROM THE SERVICE AGAIN'].value_counts(normalize = True)
```

Out[29]:
```
Likely            0.575
Neutral           0.225
Unlikely          0.075
Highly likely     0.075
Highly unlikely   0.050
Name: Likelihood of BUYING FROM THE SERVICE AGAIN, dtype: float64
```

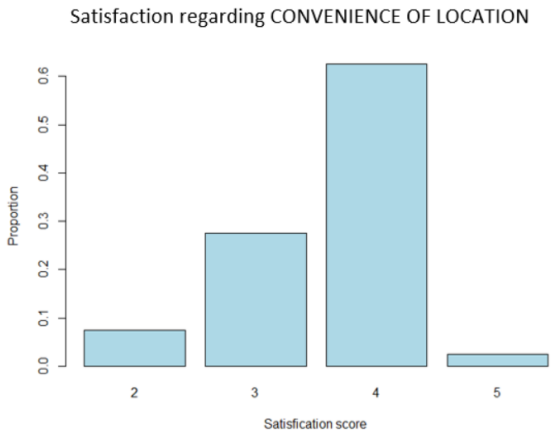

Satisfaction regarding OPTIONS AVAILABLE
Proportion
0.0
0.1
0.2
0.3
0.4
1
2
3
4
5
Satisfication score

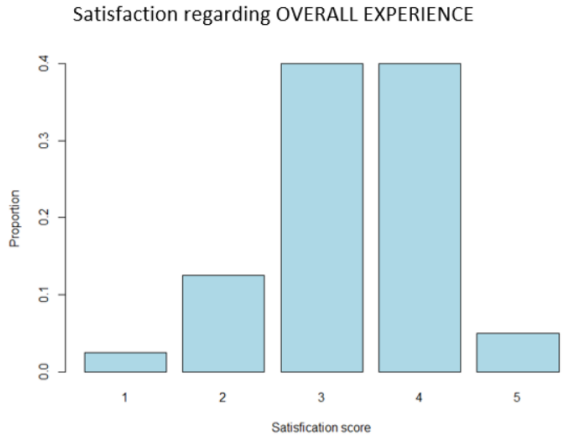

Satisfaction regarding PRICING
Proportion
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
1
2
3
4
Satisfication score

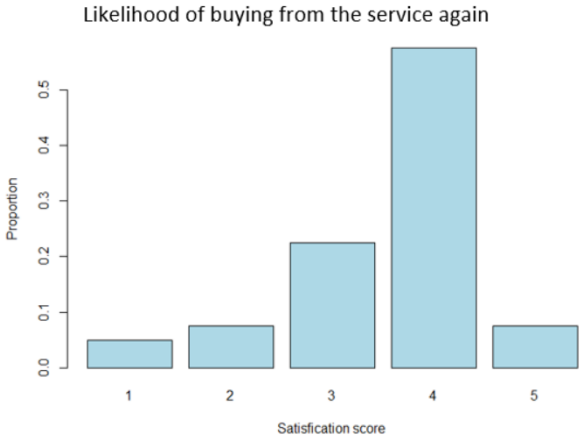

Satisfaction regarding QUALITY OF FOOD
Proportion
0.0
0.1
0.2
0.3
0.4
0.5
1
2
3
4
Satisfication score


Satisfaction regarding SERVICE
Proportion
0.0
0.1
0.2
0.3
0.4
1
2
3
4
5
Satisfication score


Satisfaction regarding CLEANLINESS
Proportion
0.0
0.1
0.2
0.3
0.4
2
3
4
5
Satisfication score


Satisfaction regarding CONVENIENCE OF LOCATION
Proportion
0.0
0.1
0.2
0.3
0.4
0.5
0.6
2
3
4
5
Satisfication score


Satisfaction regarding OVERALL EXPERIENCE
Proportion
0.0
0.1
0.2
0.3
0.4
1
2
3
4
5
Satisfication score


Likelihood of buying from the service again
Proportion
0.0
0.1
0.2
0.3
0.4
0.5
1
2
3
4
5
Satisfication score

Technical Report - Attachment 4

Cronbach's alpha calculation

$$\alpha = (\frac{k}{k-1})(1-\frac{\sum_{i=1}^{k}\sigma_{y_i}^2}{\sigma_x^2})$$

where k is the number of questions, $\sum_{i=1}^{k}\sigma_{y_i}^2$ is the sum of the variances of each item, and σ_x^2 is the variance of the total scores of each respondent

$k = 8$

$\sum_{i=1}^{8}\sigma_{y_i}^2 = 0.68786982 + 0.93639053 + 0.40976331 + 0.47928994 + 0.39792899 + 0.32100592 + 0.62130178 + 0.8$

$= 4.71893491$

$\sigma_x^2 = 14.8224852$

$\alpha = (\frac{8}{7})(1 - \frac{4.71893491}{14.8224852}) = 0.779$

(computed using Excel)

Source: https://data.library.virginia.edu/using-and-interpreting-cronbachs-alpha/