SMDM Project Business Report

DSBA

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PGP-DSBA Online

JULY' 21 Batch

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Problem - 1

Summary

A wholesale distributor operating in different regions of Portugal has information on the annual spending of several items in their stores across different regions and channels. The dataset consists of annual spending cost for the products from the large retailers on 6 different varieties of products in 3 different regions (Lisbon, Oporto, Other) and across different sales channels (Hotel, Retail).In this problem statement, we will explore the different attributes of cost spent on different products based on region and channel.

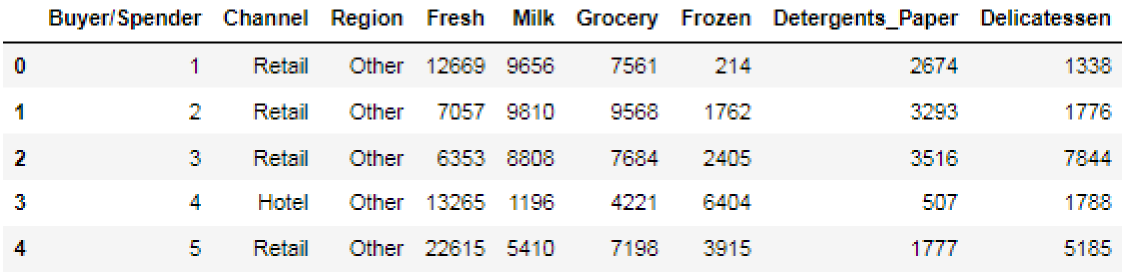
Introduction

The purpose of this exercise is to explore the dataset. The exploratory data analysis of this dataset is as wholesale distributors operating in different regions of Portugal. The annual spending of several items in their stores across different regions and channels. The dataset consists of annual spending costs for the products from the large retailers on 6 different varieties. Analyzing the different spending costs of the items can help in analyzing the amount spends across different regions and channels. This assignment helps in exploring the summary statistics.

Data Description

1. Buyer/Spender: No of buyer buying the items.
2. Channels: Distributors operating in the channels(for example: Hotel, Retail).
3. Regions: Distributors operating in the regions(for example: Lisbon, Oporto, Other) .
4.Fresh: Amount spending in the Fresh item.
5.Milk: Amount spending in the Milk item.
6.Grocery: Amount spending in the Grocery item.
7.Frozen: Amount spending in the Frozen item.
8.Detergents Paper: Amount spending in the Detergents Paper item.
9.Delicatessen: Amount spending in the Delicatessen item.

Sample of the dataset:



	Buyer/Spender	Channel	Region	Fresh	Milk	Grocery	Frozen	Detergents_Paper	Delicatessen
0	1	Retail	Other	12669	9656	7561	214	2674	1338
1	2	Retail	Other	7057	9810	9568	1762	3293	1776
2	3	Retail	Other	6353	8808	7684	2405	3516	7844
3	4	Hotel	Other	13265	1196	4221	6404	507	1788
4	5	Retail	Other	22615	5410	7198	3915	1777	5185

Table 1.Dataset Sample

Dataset has 9 variables with 6 different types of the items. Each item has different spending cost. Based on the characteristic amount spends on each item is defined.

Exploratory Data Analysis

Let us check the types of variables in the data frame.

```
Buyer/Spender     int64
Channel           object
Region            object
Fresh             int64
Milk              int64
Grocery           int64
Frozen            int64
Detergents_Paper  int64
Delicatessen      int64
dtype: object
```

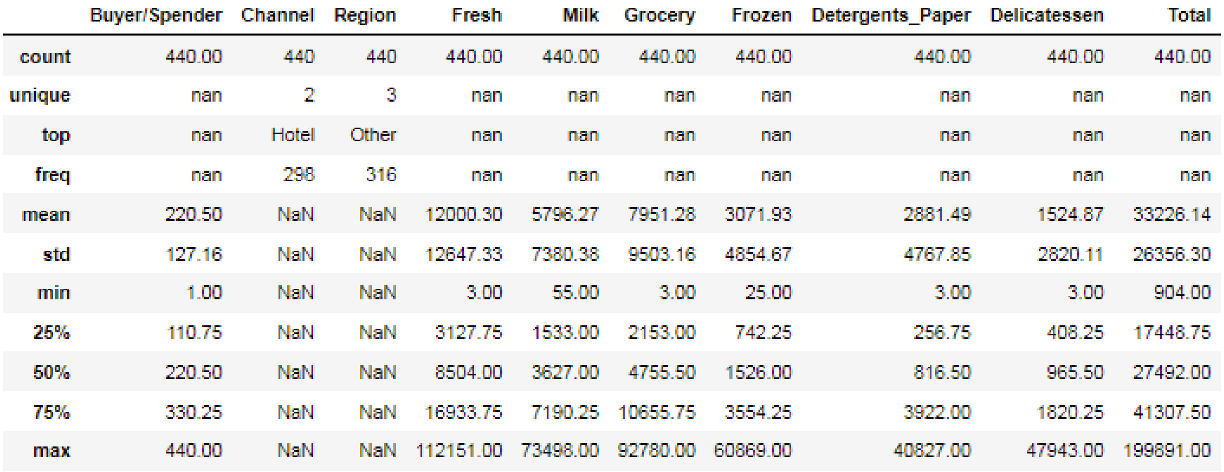
There are total 440 rows and 9 columns in the dataset. Out of 9, 2 columns (Regions and Channels) are of object type and rest 7 are of either integer data type.

Check for missing values in the dataset:

```
RangeIndex: 440 entries, 0 to 439
Data columns (total 9 columns):
Buyer/Spender       440 non-null int64
Channel             440 non-null object
Region              440 non-null object
Fresh               440 non-null int64
Milk                440 non-null int64
Grocery             440 non-null int64
Frozen              440 non-null int64
Detergents_Paper    440 non-null int64
Delicatessen        440 non-null int64
dtypes: int64(7), object(2)
memory usage: 31.0+ KB
```

1.1 Use methods of descriptive statistics to summarize data. Which Region and which Channel spent the most? Which Region and which Channel spent the least?

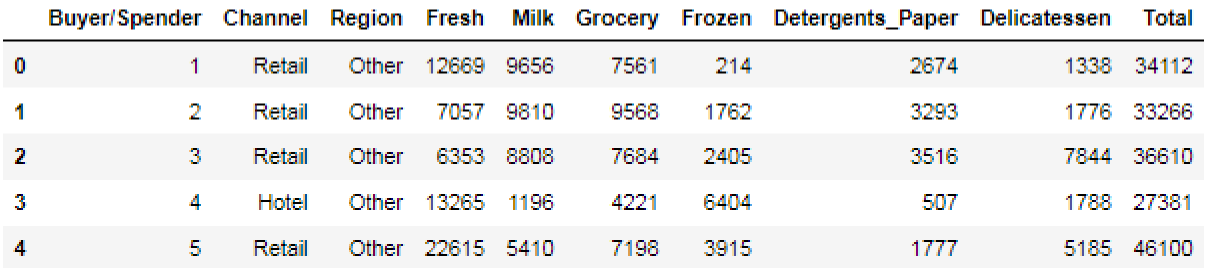
Descriptive statistics helps to describe and understand the features of a specific dataset by giving short summaries about the sample and measures of the data. The most recognized types of descriptive statistics are measures of centre: the mean, median, and mode, which are used at almost all levels of math and statistics.



	Buyer/Spender	Channel	Region	Fresh	Milk	Grocery	Frozen	Detergents_Paper	Delicatessen	Total
count	440.00	440	440	440.00	440.00	440.00	440.00	440.00	440.00	440.00
unique	nan	2	3	nan	nan	nan	nan	nan	nan	nan
top	nan	Hotel	Other	nan	nan	nan	nan	nan	nan	nan
freq	nan	298	316	nan	nan	nan	nan	nan	nan	nan
mean	220.50	NaN	NaN	12000.30	5796.27	7951.28	3071.93	2881.49	1524.87	33226.14
std	127.16	NaN	NaN	12647.33	7380.38	9503.16	4854.67	4767.85	2820.11	26356.30
min	1.00	NaN	NaN	3.00	55.00	3.00	25.00	3.00	3.00	904.00
25%	110.75	NaN	NaN	3127.75	1533.00	2153.00	742.25	256.75	408.25	17448.75
50%	220.50	NaN	NaN	8504.00	3627.00	4755.50	1526.00	816.50	965.50	27492.00
75%	330.25	NaN	NaN	16933.75	7190.25	10655.75	3554.25	3922.00	1820.25	41307.50
max	440.00	NaN	NaN	112151.00	73498.00	92780.00	60869.00	40827.00	47943.00	199891.00

Table- 1.1.1. Summary of the data

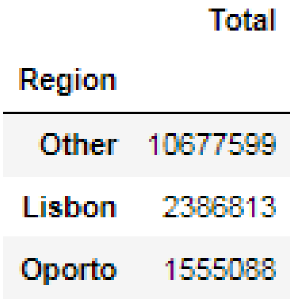
From the descriptive statistics, we can see that there are 440 Buyers/Spender in the dataset. 'Hotel' is the most frequent Channel and 'Other' is most frequent Region. The average price of the overall dataset is 33226.14. There are 2 unique Channel and 3 unique Region in the dataset. **"Nan"** shows that the values cannot be calculated for that particular variables. Like we can calculate mean for a categorical/object type variable. And in a same way unique value for a numerical variable.



	Buyer/Spender	Channel	Region	Fresh	Milk	Grocery	Frozen	Detergents_Paper	Delicatessen	Total
0	1	Retail	Other	12669	9656	7561	214	2674	1338	34112
1	2	Retail	Other	7057	9810	9568	1762	3293	1776	33266
2	3	Retail	Other	6353	8808	7684	2405	3516	7844	36610
3	4	Hotel	Other	13265	1196	4221	6404	507	1788	27381
4	5	Retail	Other	22615	5410	7198	3915	1777	5185	46100

Table-1.1.2. Calculating total spent.

Calculating the Highest and Least amount spent on each Region



	Total
Region	
Other	10677599
Lisbon	2386813
Oporto	1555088

Table-1.1.3. Total vs Region

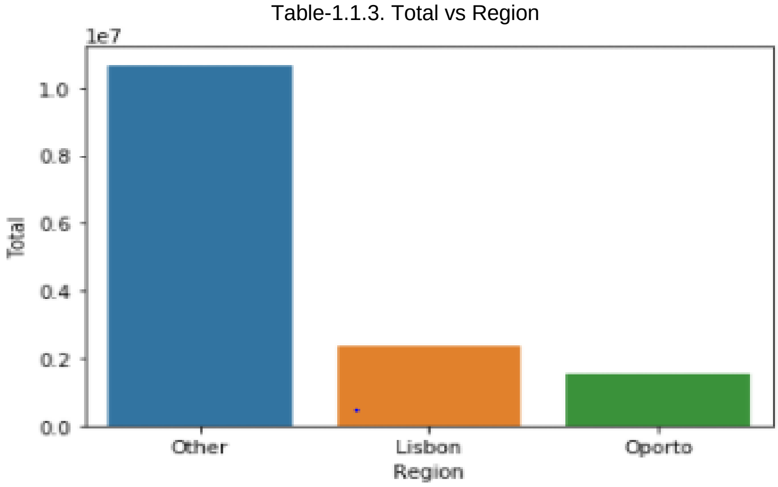
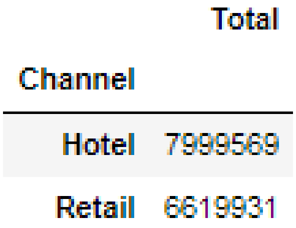


Fig - 1.1.1 Total vs. Region Bar Plot

Inferred from the above tables, we found the amount spent on the **other region** is the **highest** and the amount spent on the **Oporto region** is the **least**.

Calculating the Highest and Least amount spent on each Channel



	Total
Channel	
Hotel	7999569
Retail	6619931

Table-1.1.5. Total vs Channel

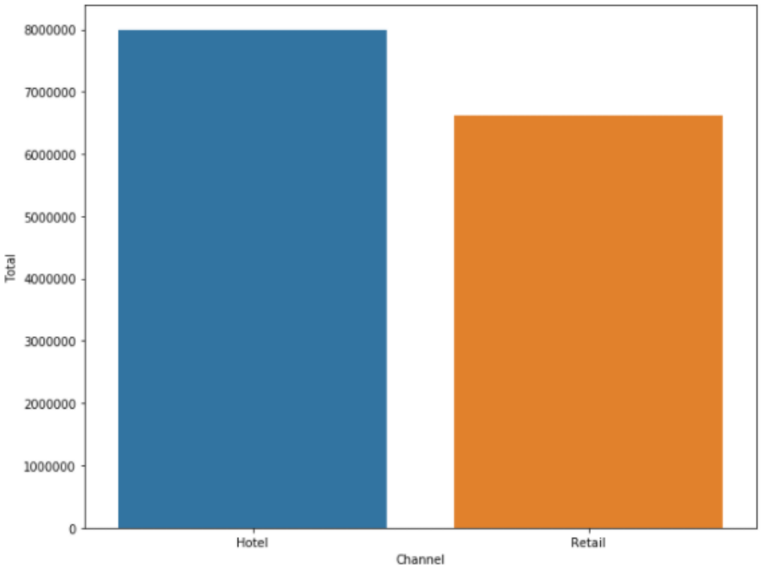
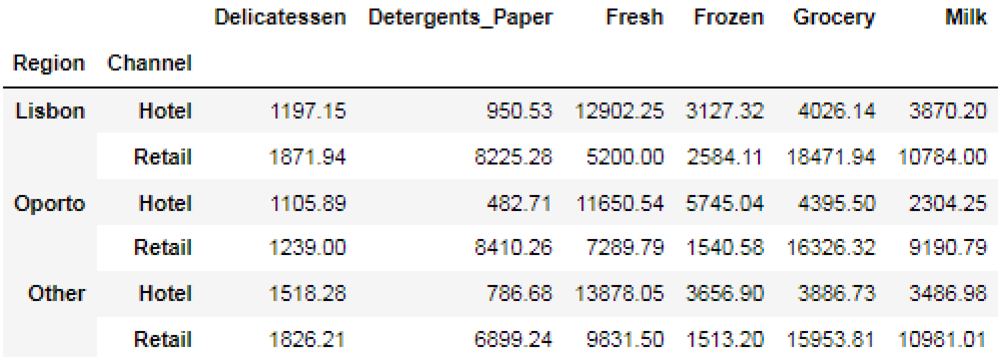


Fig – 1.1.2. Total vs Channel. Total Bar Plot

Inferred from the above tables, we found the amount spent on the **hotel channel** is the **highest** and the amount spent on the **Retail channel** is the **least**.

1.2 There are 6 different varieties of items that are considered. Describe and comment/explain all the varieties across Region and Channel? Provide a detailed justification for your answer.

There are 6 different varieties of items are considered across regions and channel.



		Delicatessen	Detergents_Paper	Fresh	Frozen	Grocery	Milk
Region	**Channel**						
Lisbon	**Hotel**	1197.15	950.53	12902.25	3127.32	4026.14	3870.20
	Retail	1871.94	8225.28	5200.00	2584.11	18471.94	10784.00
Oporto	**Hotel**	1105.89	482.71	11650.54	5745.04	4395.50	2304.25
	Retail	1239.00	8410.26	7289.79	1540.58	16326.32	9190.79
Other	**Hotel**	1518.28	786.68	13878.05	3656.90	3886.73	3486.98
	Retail	1826.21	6899.24	9831.50	1513.20	15953.81	10981.01

Table – 1.2 Items across Regions and Channels

In 'Lisbon' Region 'Delicatessen' is higher in the 'Retail' channel with that of the 'Hotel' channel. Highest amount spent on the item 'Fresh' than the other items in 'Hotel' channel, whereas in 'Retail' channel 'Grocery' has the highest amount spent.

In 'Oporto' Region, 'Detergents Paper' is the least amount spent in the 'Hotel' channel whereas 'Detergents Paper' is the third highest amount spent in the 'Retail' Channel. 'Fresh' and 'Grocery' is the item where highest amount spent in the channels 'Hotel' and 'Retail'.

In 'Other' Region, the amount spent on items 'Milk', 'Frozen' and 'Grocery' was almost the same in the 'Hotel' channel. In 'Retail' Channel, the amount spent on the 'Frozen' is least amount spent.

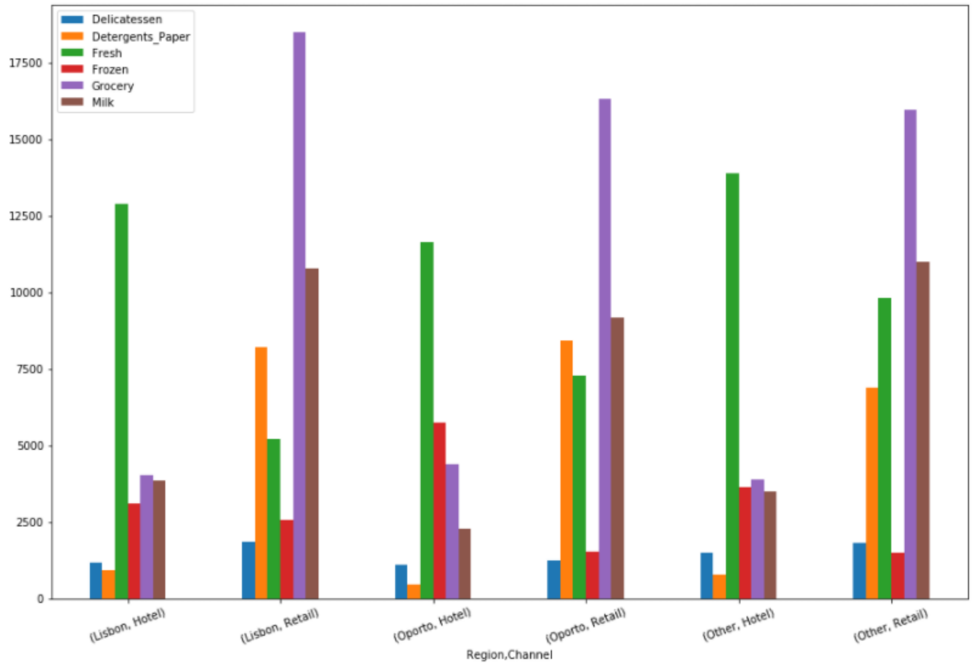
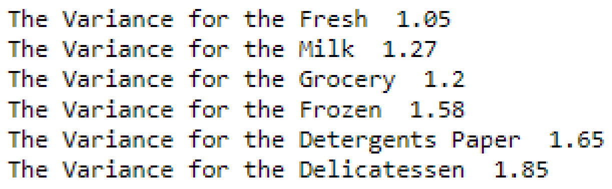


Fig – 1.2 Items across Regions and Channels

1.3 On the basis of a descriptive measure of variability, which item shows the most inconsistent behaviour? Which items show the least inconsistent behaviour?

Calculating the variance

The variance is the ratio of standard deviation to that of the mean.



```
The Variance for the Fresh  1.05
The Variance for the Milk  1.27
The Variance for the Grocery  1.2
The Variance for the Frozen  1.58
The Variance for the Detergents Paper  1.65
The Variance for the Delicatessen  1.85
```

Fig – 3 Calculating variance for each items

From the descriptive statistics, we can calculate variance for each of the items. Which item has the least variance has the least inconsistent behaviour. From this inference, **Fresh** item has the **least inconsistent** behaviour with the value of **1.05** and the **Delicatessen** item has the **most inconsistent** behaviour with the value of **1.85**

1.4 Are there any outliers in the data? Back up your answer with a suitable plot/technique with the help of detailed comments?

From the descriptive statistics, we can find the outliers by plotting the values in the boxplot.

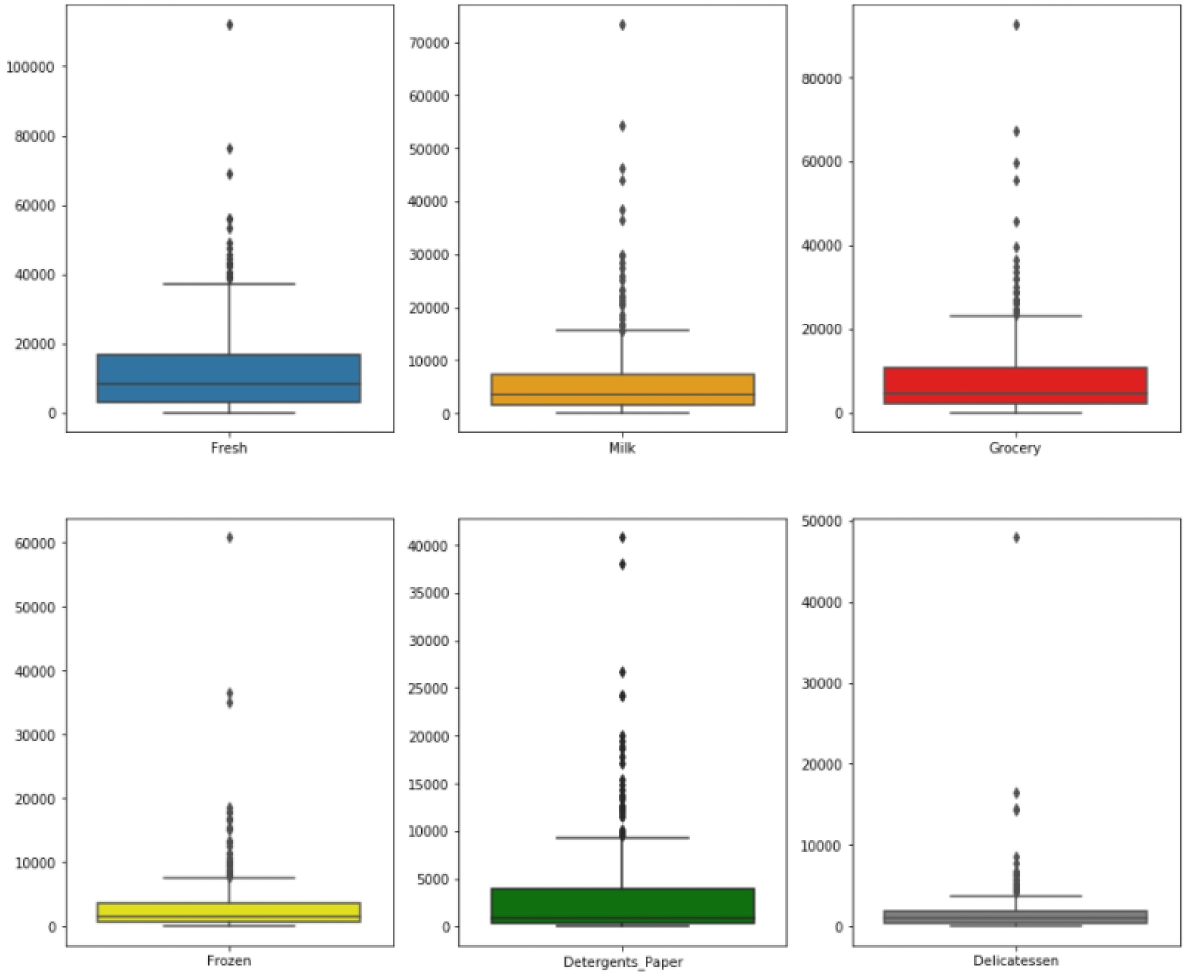


Fig – 4 Boxplots for each item

All the values of each item from the dataset have been plotted in the boxplot. Inferred from the boxplot, Items (Fresh, Milk, Grocery, Frozen, Detergents_Paper, Delicatessen) has the outliers.

1.5 On the basis of your analysis, what are your recommendations for the business? How can your analysis help the business to solve its problem? Answer from the business perspective?

As per the Descriptive analysis, I find out from the Coefficient of Variation that there are inconsistencies in spending of different items, which should be reduced. The spending for the Hotel and Retail channel should be more or less equal, but here they are different which needs to be addressed. And also spending should be equal for different regions. Need to focus on spending for other items than the “Fresh” and “Grocery”.

Problem – 2

Summary

The Student News Service at Clear Mountain State University (CMSU) has decided to gather data about the undergraduate students that attend CMSU. The dataset consists of responses from 62 undergraduates. In this problem statement, we will explore the different questions that has been created by CMSU for the survey and analysis the response from the undergraduates.

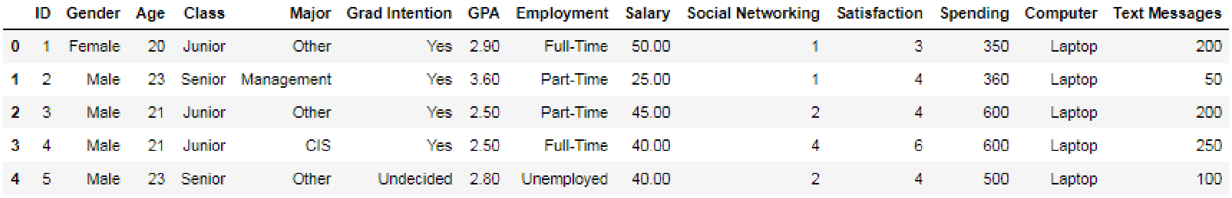
Introduction

The purpose of this exercise is to explore the dataset. The exploratory data analysis of this dataset is the Student News Service at Clear Mountain State University (CMSU). The survey took from the undergraduates students at the Student News Service at Clear Mountain State University (CMSU). The dataset consists of survey responses of 62 undergraduates from the clear mountain state university. This assignment helps in exploring the responses made by the undergraduates provide inferential statistics.

Data Description

1. ID: No of undergraduates responded.
2. Gender: Describe the sex (for example: Male, Female).
3. Age: Describe the responded graduate age.
4. Class: Describe the grades.
5. Major: Describe the department of their studies.
6. Grad Intention: Describe about their further education.
7. GPA: Marks persuaded in the class.
8. Employment: Employment status of the undergraduates.
9. Salary: Undergraduate employment salary details.
10. Social Networking: No of social network.
11. Satisfaction: Rated how satisfied they are.
12. Spending: Describe the expenditure of each undergraduate.
13. Computer: Describe the computer of each undergraduate.
14. Text Messages: Describe the number of text messages.

Sample of the dataset:



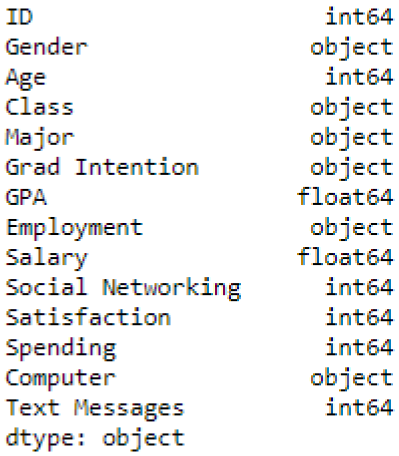
	ID	Gender	Age	Class	Major	Grad Intention	GPA	Employment	Salary	Social Networking	Satisfaction	Spending	Computer	Text Messages
0	1	Female	20	Junior	Other	Yes	2.90	Full-Time	50.00	1	3	350	Laptop	200
1	2	Male	23	Senior	Management	Yes	3.60	Part-Time	25.00	1	4	360	Laptop	50
2	3	Male	21	Junior	Other	Yes	2.50	Part-Time	45.00	2	4	600	Laptop	200
3	4	Male	21	Junior	CIS	Yes	2.50	Full-Time	40.00	4	6	600	Laptop	250
4	5	Male	23	Senior	Other	Undecided	2.80	Unemployed	40.00	2	4	500	Laptop	100

Table 2.Dataset Sample

Dataset has 14 variables with student details. Based on the characteristic Student details in the CMSU is defined.

Exploratory Data Analysis

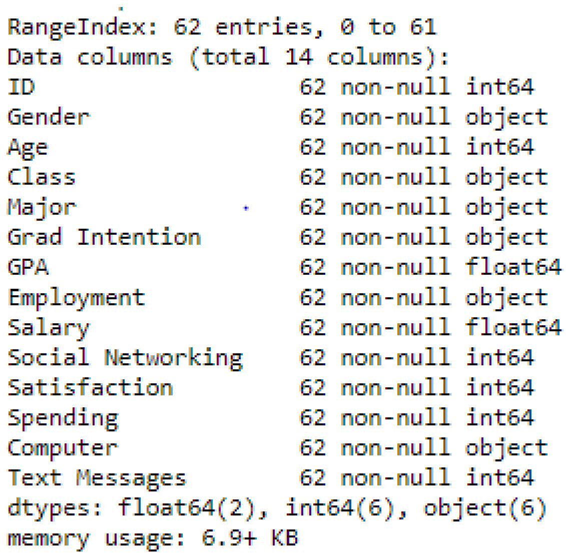
Let us check the types of variables in the data frame.



```
ID                      int64
Gender                 object
Age                     int64
Class                  object
Major                  object
Grad Intention         object
GPA                   float64
Employment             object
Salary                float64
Social Networking       int64
Satisfaction            int64
Spending                int64
Computer               object
Text Messages           int64
dtype: object
```

There are total 62 rows and 14 columns in the dataset. Out of 14, 6 columns are of object type, 2 columns are of float (Decimal value) type and rest 6 are of either integer data type.

Check for missing values in the dataset:



```
RangeIndex: 62 entries, 0 to 61
Data columns (total 14 columns):
ID                    62 non-null int64
Gender                62 non-null object
Age                   62 non-null int64
Class                 62 non-null object
Major                 62 non-null object
Grad Intention        62 non-null object
GPA                   62 non-null float64
Employment            62 non-null object
Salary                62 non-null float64
Social Networking     62 non-null int64
Satisfaction          62 non-null int64
Spending              62 non-null int64
Computer              62 non-null object
Text Messages         62 non-null int64
dtypes: float64(2), int64(6), object(6)
memory usage: 6.9+ KB
```

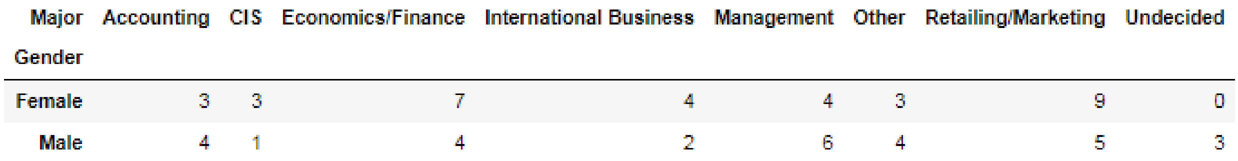
From this, it is clear that there are no null values present in the dataset.

2.1. For this data, construct the following contingency tables (Keep Gender as row variable)

Contingency Table: A table showing the distribution of one variable in rows and another in columns, used to study the correlation between the two variables.

2.1.1. Gender and Major

Contingency table is plotted against gender vs. Major. From this we can infer that no of female and male persue across different majors.

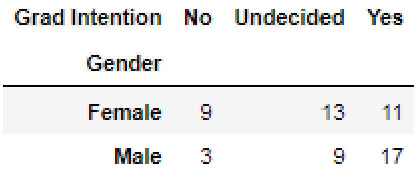


Major	Accounting	CIS	Economics/Finance	International Business	Management	Other	Retailing/Marketing	Undecided
Gender								
Female	3	3	7	4	4	3	9	0
Male	4	1	4	2	6	4	5	3

Table 2.1.1.Gender vs. Major

2.1.2. Gender and Grad Intension

Contingency table is plotted against gender vs. Grad Intension. From this we can infer that no of female and male have graduation intensions.

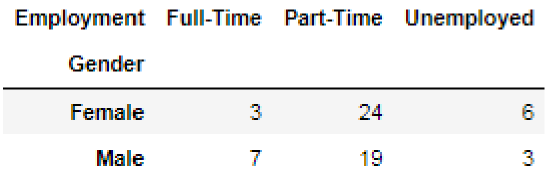


Grad Intention	No	Undecided	Yes
Gender			
Female	9	13	11
Male	3	9	17

Table 2.1.2.Gender vs. Major

2.1.3. Gender and Employment

Contingency table is plotted against gender vs. Employment. From this we can infer that no of female and male have Employed and Unemployed.

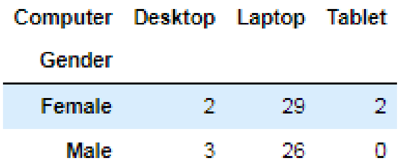


Employment	Full-Time	Part-Time	Unemployed
Gender			
Female	3	24	6
Male	7	19	3

Table 2.1.3.Gender vs. Employment

2.1.4. Gender and Computer

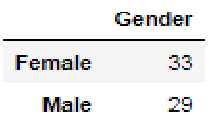
Contingency table is plotted against gender vs. Computer. From this we can infer that no of female and male have which type of computer.



Computer	Desktop	Laptop	Tablet
Gender			
Female	2	29	2
Male	3	26	0

Table 2.1.4.Gender vs. Computer

2.2. Assume that the sample is representative of the population of CMSU. Based on the data, answer the following question:



	Gender
Female	33
Male	29

Table 2.2 Gender count

2.2.1. What is the probability that a randomly selected CMSU student will be male?

Probability of male = total male student / total student

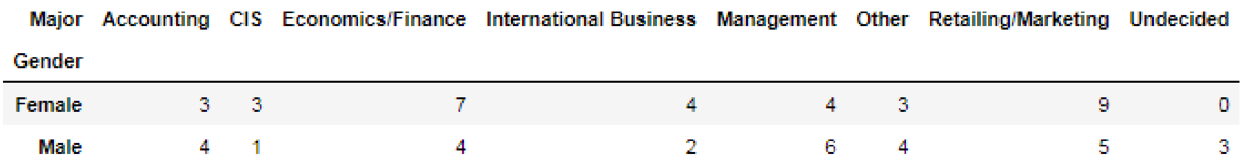
Probability_male = 29 / 62 = 0.46774193548387094

2.2.2. What is the probability that a randomly selected CMSU student will be female?

Probability of female = total female student / total student

Probability_female = 33 / 62 = 0.532258064516129

2.3. Assume that the sample is representative of the population of CMSU. Based on the data, answer the following question:



Major	Accounting	CIS	Economics/Finance	International Business	Management	Other	Retailing/Marketing	Undecided
Gender								
Female	3	3	7	4	4	3	9	0
Male	4	1	4	2	6	4	5	3

Table 2.3 Gender vs. Major

2.3.1. Find the conditional probability of different majors among the male students in CMSU.

Probability of Accounting male = Total Accounting male student / Total Male student

Probability_Accounting_male = 4 / 29 = 0.13793103448275862

Probability of CIS male = Total CIS male student / Total Male student

Probability_CIS_male = 1 / 29 = 0.034482758620689655

Probability of Economics/Finance male = Total (Economics/Finance) male student / Total Male student

Probability_Economics_Finance_male = 4 / 29 = 0.13793103448275862

Probability of International Business male = Total International Business male student / Total Male student

Probability_International_Business_male = 2 / 29 = 0.06896551724137931

Probability of Management male = Total Management male student / Total Male student

Probability_Management_male = 6 / 29 = 0.20689655172413793

Probability of Other male = Total Other male student / Total Male student

Probability_Other_male = 4 / 29 = 0.13793103448275862

Probability of Retailing male = Total Retailing male student / Total Male student

Probability_Retailing_male = 5 / 29 = 0.1724137931034483

Probability of Undecided male = Total Undecided male student / Total Male student

Probability_Undecided_male = 3 / 29 = 0.10344827586206896

2.3.2. Find the conditional probability of different majors among the female students in CMSU.

Probability of Accounting female = Total Accounting female student / Total female student

Probability_Accounting_female = 3 / 32 = 0.09090909090909091

Probability of CIS female = Total CIS female student / Total female student

Probability_CIS_female = 3 / 32 = 0.09090909090909091

Probability of Economics/Finance female = Total (Economics/Finance) female student / Total female student

Probability_Economics_Finance_female = 7 / 32 = 0.21212121212121213

Probability of International Business female = Total International Business female student / Total female student

Probability_International_Business_female = 4 / 32 = 0.12121212121212122

Probability of Management female = Total Management female student / Total female student

Probability_Management_female = 4 / 32 = 0.12121212121212122

Probability of Other female = Total Other female student / Total female student

Probability_Other_female = 3 / 32 = 0.09090909090909091

Probability of Retailing female = Total Retailing female student / Total female student

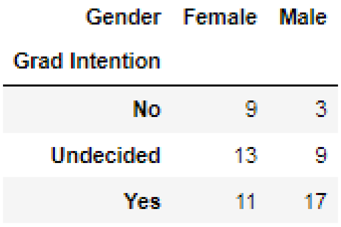
Probability_Retailing_female = 9 / 32 = 0.2727272727272727

Probability of Undecided female = Total Undecided female student / Total female student

Probability_Undecided_female = 0 / 32 = 0.0

2.4. Assume that the sample is a representative of the population of CMSU. Based on the data, answer the following question:

2.4.1. Find the probability that a randomly chosen student is a male and intends to graduate.



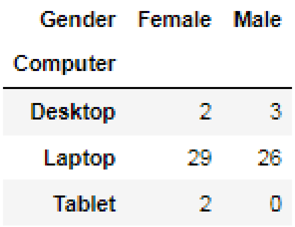
Gender	Female	Male
Grad Intention		
No	9	3
Undecided	13	9
Yes	11	17

Table 2.4.1 Gender vs. Grad Intension

Probability of Male with grad Intensions = (Total male student / Total student)*(male with grad intentions / total male student)

Probability_male_with_grad_intension = (29 / 62)*(17 / 29) = 0.27419354838709675

2.4.2 Find the probability that a randomly selected student is a female and does NOT have a laptop.



Gender	Female	Male
Computer		
Desktop	2	3
Laptop	29	26
Tablet	2	0

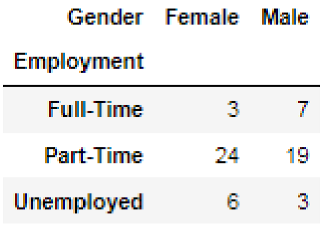
Table 2.4.2 Gender vs. Computer

Probability of Female without laptop= (Total female student / Total student)*((female with desktop + female with tablet)/ total female student)

Probability_female_without_laptop = (33 / 62)*((2 + 2) / 33) = 0.06451612903225806

2.5. Assume that the sample is representative of the population of CMSU. Based on the data, answer the following question:

2.5.1. Find the probability that a randomly chosen student is a male or has full-time employment?



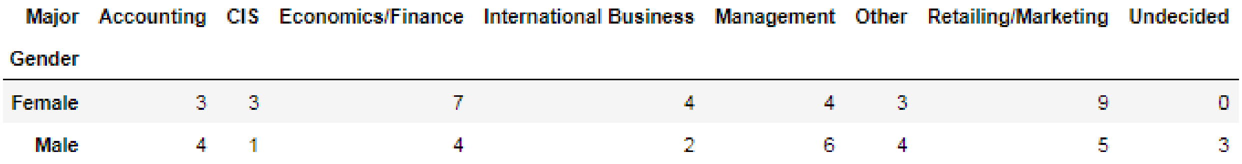
Gender	Female	Male
Employment		
Full-Time	3	7
Part-Time	24	19
Unemployed	6	3

Table 2.5.1 Gender vs. Employment

Probability of male or full-time Employent = (Total Male student + Total student – Total male student having full-time employment / total student)

Probability_male_or_full-time_employment = (29 + 10 – 7 / 62) = 0.5161290322580645

2.5.2. Find the conditional probability that given a female student is randomly chosen, she is majoring in international business or management.



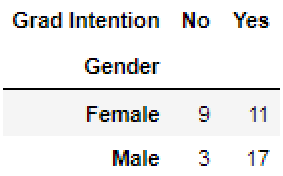
Major	Accounting	CIS	Economics/Finance	International Business	Management	Other	Retailing/Marketing	Undecided
Gender								
Female	3	3	7	4	4	3	9	0
Male	4	1	4	2	6	4	5	3

Table 2.5.2 Gender vs. Major

Probability of male or full-time Employent = (Total Male student + Total student – Total male student having full-time employment / total student)

Probability_male_or_full-time_employment = (29 + 10 – 7 / 62) = 0.5161290322580645

2.6. Construct a contingency table of Gender and Intent to Graduate at 2 levels (Yes/No). The Undecided students are not considered now and the table is a 2x2 table. Do you think the graduate intention and being female are independent events?



Grad Intention	No	Yes
Gender		
Female	9	11
Male	3	17

Table 2.6 Gender vs. Grad Intention

Inference from the above contingency table, ***being female and having Grad Intention are not two independent variables.***

2.7. Note that there are four numerical (continuous) variables in the data set, GPA, Salary, Spending, and Text Messages.

Answer the following questions based on the data

2.7.1. If a student is chosen randomly, what is the probability that his/her GPA is less than 3?

Probability of student GPA less than 3 = (Total student with GPA less than 3 / total student)

Probability_student_GPA_LT_3 = 17 / 62 = 0.27419354838709675

2.7.2. Find the conditional probability that a randomly selected male earns 50 or more. Find the conditional probability that a randomly selected female earns 50 or more.

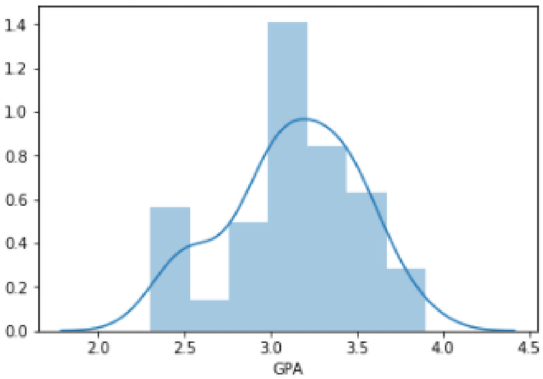
Probability of Male earns greater than 50 = (Total male student and earns greater than 50 / total student)

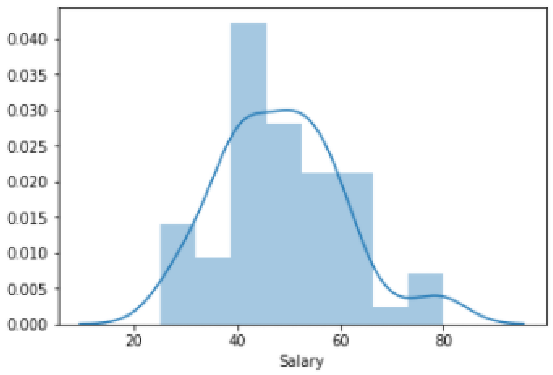
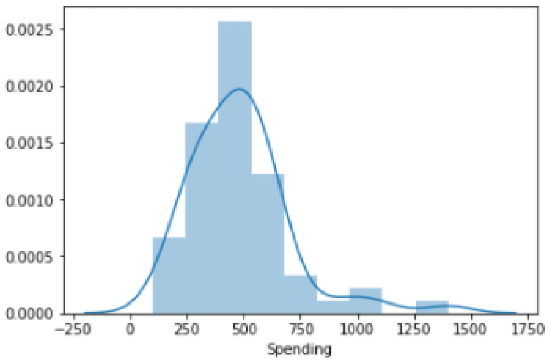
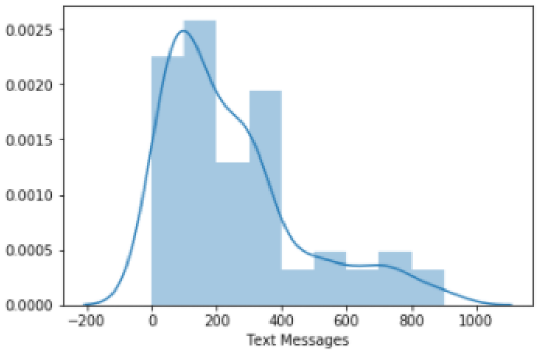
Probability_Male_and_earns_GT_50 = 14 / 62 = 0.22580645161290322

Probability of Female earns greater than 50 = (Total female student and earns greater than 50 / total student)

Probability_Female_and_earns_GT_50 = 18 / 62 = 0.2903225806451613

2.8. Note that there are four numerical (continuous) variables in the data set, GPA, Salary, Spending, and Text Messages. For each of them comment whether they follow a normal distribution. Write a note summarizing your conclusions.

Column Name	Mean, Mode, Median, Shapiro test Result	Normal Distribution plot	Comment follows Normal Distribution(N.D)
GPA	***mean*** 3.129032 258064516 ***Mode*** - 0 3.00 1 3.10 2 3.40 dtype: float64 ***Median*** - 3.150 0000000000004 ***Shapiro test*** ***P- value*** - 0.1120 4058676958084	 Fig 2.8.1. GPA bell curve	Mean, Mode and Median are approximately equal and from the bell curve and from the Shapiro test, ***GPA follows the normal distribution***

Salary	***mean*** - 48.54838709677419 ***Mode*** - 0 40.00 dtype: float64 ***Median*** - 50.0 ***Shapiro test*** ***P- value*** - 0.028000956401228905	 Fig 2.8.2. Salary bell curve	Mean, Mode and Median are approximately equal and from the Shapiro test, ***salary does not follows the normal distribution***
Spending	***mean*** - 482.01612903225805 ***Mode*** - 0 500 dtype: int64 ***Median*** - 500.0 ***Shapiro test*** ***P- value*** - 1.6854661225806922e-05	 Fig 2.8.3. Spending bell curve	Mean, Mode and Median are approximately equal and from the Shapiro test, ***Spending does not follows the normal distribution***
Text Messages	***mean*** - 246.20967741935485 ***mode*** - 0 300 dtype: int64 ***median*** - 200.0 ***Shapiro test*** ***P- value*** - 4.324040673964191e-06	 Fig 2.8.4. Text Messages bell curve	Mean, Mode and Median are approximately equal and from the Shapiro test, ***Text Messages does not follows the normal distribution***

Problem – 3

Summary

The two companies has decided to gather data about the ABC asphalt Shingles. The dataset consists of amount of moisture contains in the shingles. In this problem statement, we will explore the different questions that has been created from the customer feedback about the moisture content present in the shingles is less than 0.35 pounds per 100 square feet and analysis the response from the hypothesis testing.

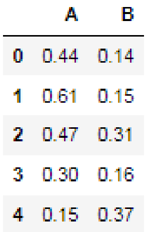
Introduction

The purpose of this exercise is to explore the dataset. The exploratory data analysis of this dataset is the shingles contain moisture content. The dataset consists of shingles with the moisture content. This assignment helps in exploring the Shingles manufacturing company whether shingles contain moisture content is less than 0.35 pounds 100 square feet with the hypothesis testing.

Data Description

1. A: Company A with moisture content in shingles.
2. B: Company B with moisture content in shingles.

Sample of the dataset:



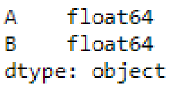
	A	B
0	0.44	0.14
1	0.61	0.15
2	0.47	0.31
3	0.30	0.16
4	0.15	0.37

Table 3.1.Dataset Sample

Dataset has 2 variables, A company and B company moisture content in Shingles. Based on the characteristic moisture content in Shingles A & B company is defined.

Exploratory Data Analysis

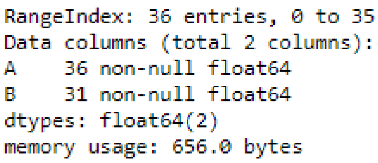
Let us check the types of variables in the data frame.



```
A    float64
B    float64
dtype: object
```

There are total 36 measurements (in pounds per 100 square feet) for A shingles and 31 measurements (in pounds per 100 square feet) for B shingles. 2 columns are of float (Decimal value).

Check for missing values in the dataset:



```
RangeIndex: 36 entries, 0 to 35
Data columns (total 2 columns):
A    36 non-null float64
B    31 non-null float64
dtypes: float64(2)
memory usage: 656.0 bytes
```

From this, it is clear that there are no null values present in the dataset. Column A has 36 measurements and 31 measurements

3.1 Do you think there is evidence that means moisture contents in both types of shingles are within the permissible limits? State your conclusions clearly showing all steps.

For the A shingles, the null and alternative hypothesis to test whether the population mean moisture content is less than 0.35 pound per 100 square feet is given:

$$H_0 \geq 0.35$$

$$H_1 < 0.35$$

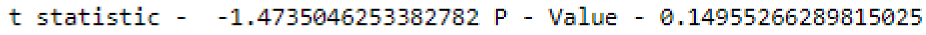
Null Hypothesis: Population mean moisture content greater than or equal to 0.35 moisture content.

Alternate Hypothesis: Population mean moisture content lesser than 0.35 moisture content at 95% confidence level.

The level of significance – 0.05

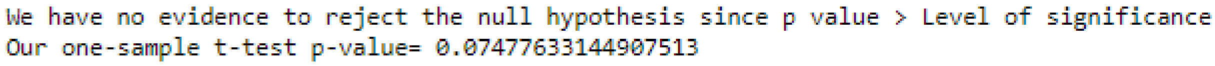
One sample t test is used for finding the moisture content in company A and company B

For Company A



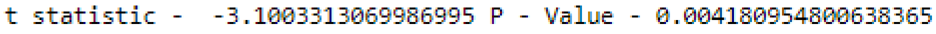
```
t statistic -  -1.4735046253382782 P - Value - 0.14955266289815025
```

From this, we get T statistics and P value for Company A.



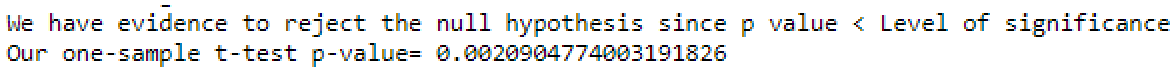
```
We have no evidence to reject the null hypothesis since p value > Level of significance
Our one-sample t-test p-value= 0.07477633144907513
```

For Company B



```
t statistic -  -3.1003313069986995 P - Value - 0.004180954800638365
```

From this, we get T statistics and P value for Company B.



```
We have evidence to reject the null hypothesis since p value < Level of significance
Our one-sample t-test p-value= 0.002090477400319182б
```

From the T statistics, At 95% confidence level, where Company A has the moisture level is lesser than 0.35 pounds per 100 square feet. Whereas, Company B has a higher moisture content in Shingles.

3.2 Do you think that the population mean for shingles A and B are equal? Form the hypothesis and conduct the test of the hypothesis. What assumption do you need to check before the test for equality of means is performed?

For the A shingles, the null and alternative hypothesis to test whether the population mean moisture content is less than 0.35 pound per 100 square feet is given:

H0 : mu_A == mu_B

H1 : mu_A != mu_B

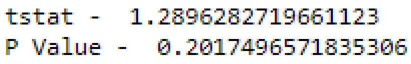
Null Hypothesis: Population mean moisture content in company A Shingles is equal to moisture content in company B Shingles.

Alternate Hypothesis: Population mean moisture content in company A Shingles is not equal to moisture content in company B Shingles.

The level of significance – 0.05

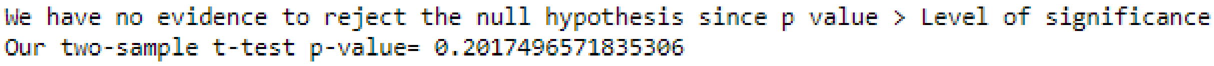
Two sample t test is used for finding the moisture content in company A and company B,

The output from two sample t test, we get



```
tstat -  1.2896282719661123
P Value -  0.2017496571835306
```

From this, we get T statistics and P value.



```
We have no evidence to reject the null hypothesis since p value > Level of significance
Our two-sample t-test p-value= 0.2017496571835306
```

From this, we conclude that, Both Company A and Company B population mean and moisture content in shingles is not equal.

Assumptions,

The Population to be normal and the variance of the two companies needs to be equal. If these assumptions were n ot met, then needs to proceed with alternate hypothesis testing.