

Assignment 2

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BSC Applied Computing
Data Analysis and Visualisation
Assignment 2

Section A

Case Study: Sales Analysis

Background:

You are working for a retail company that operates multiple stores across different cities. The company is interested in analysing the sales data to gain insights into the performance of its stores and make informed business decisions.



Section A – Descriptive Statistics

Question 1:

The company collected sales data from five different stores for the past month. The dataset includes the daily sales in thousands of pounds for each store. Use descriptive statistics to analyze the data and answer the following questions:

- a) Calculate the mean, median, and mode for the daily sales of each store. Discuss how these measures provide insights into the central tendency of the sales distribution. (8 marks)

Store	Product Category	Daily Sales (In thousands of pounds)	Average customer rating (on a scale of 1 to 5)	Location
4	Electronics	5	3.6	Rural
3	Home Goods	8	4.1	Rural
4	Electronics	8	3.6	Rural
2	Apparel	10	3.8	Urban
3	Home Goods	10	4.1	Rural
4	Electronics	10	3.6	Rural
1	Electronics	12	4.2	Urban
2	Apparel	12	3.8	Urban
3	Home Goods	12	4.1	Rural
4	Electronics	12	3.6	Rural
3	Home Goods	14	4.1	Rural
1	Electronics	15	4.2	Urban
2	Apparel	15	3.8	Urban
4	Electronics	15	3.6	Rural
3	Home Goods	16	4.1	Rural
1	Electronics	18	4.2	Urban
2	Apparel	18	3.8	Urban
3	Home Goods	18	4.1	Rural
5	Home Goods	18	4.5	Urban

1	Electronics	20	4.2	Urban
1	Electronics	20	4.2	Urban
2	Apparel	20	3.8	Urban
4	Electronics	20	3.6	Rural
5	Home Goods	20	4.5	Urban
4	Electronics	22	3.6	Rural
5	Home Goods	22	4.5	Urban
1	Electronics	25	4.2	Urban
5	Home Goods	25	4.5	Urban
1	Electronics	28	4.2	Urban
5	Home Goods	28	4.5	Urban
5	Home Goods	30	4.5	Urban

Meanings

Mean – Mean is every number added together and divided by how many numbers there are.

Median – Median is the middle number

Mode – Mode is the most common number

Excel functions

Mean : =AVERAGE ()

Median : =MEDIAN ()

Mode : =MODE()

Store 1:

Daily Sales – 12, 15, 18, 20, 20, 25, 28

Mean – $12 + 15 + 18 + 20 + 20 + 25 + 28 = 138 / 7 = 19.7$

Median – 20

Mode – 20

Discussion – This data suggests that store 1 has a relatively balanced distribution. This is due to the mean and median being very close

Store 2:

Daily Sales – 10, 12, 15, 18, 20

Mean – $10 + 12 + 15 + 18 + 20 = 75 / 5 = 15$

Median – 15

Mode – N/A

Discussion – Due to the mean and median being the same, it indicates that store 2 has a symmetric distribution. However, because there is no mode, it implies that store 2s sales values are without repetition

Store 3:

Daily Sales – 8, 10, 12, 14, 16, 18

Mean – $8 + 10 + 12 + 14 + 16 + 18 = 78 / 6 = 13$

Median – 13

Mode – N/A

Discussion - Due to the mean and median being the same, it indicates that store 3 has a symmetric distribution.

Store 4:

Daily Sales – 5, 8, 10, 12, 15, 20, 22

Mean – $5 + 8 + 10 + 12 + 15 + 20 + 22 = 13.1$

Median – 12

Mode – N/A

Discussion – The mean and the median are quite close. However, store 4 has the mode of 8 being the most frequent. Which highlights this value

Store 5:

Daily Sales – 18, 20, 22, 25, 28, 30

Mean – $18 + 20 + 22 + 25 + 28 + 30 = 143 / 6 = 23.8$

Median – 23.5

Mode – N/A

Discussion – In store 5, the means value is more than the median. This indicates a right-skewed distribution. Also, with there being no mode, it implies that store 5s values are without repetition

2

Meanings

Store 2

Store	Product Category	Daily Sales (In thousands of pounds)	Average customer rating (on a scale of 1 to 5)	Location					
2	Apparel	10	3.8	Urban			Mean	15	
2	Apparel	12	3.8	Urban			Median	15	
2	Apparel	15	3.8	Urban			Mode	#N/A	
2	Apparel	18	3.8	Urban			Variance	17	
2	Apparel	20	3.8	Urban			Range	10	
							Standard Deviation	4.12310563	

Store 3

[illegible]

Store 4

[illegible]

Store 5

17									
	A	B	C	D	E	F	G	H	I
	Store	Product Category	Daily Sales (in thousands of pounds)	Average customer rating (on a scale of 1 to 5)	Location				
1									
2	5	Home Goods	18	4.5	Urban			Mean	23.8333333
3	5	Home Goods	20	4.5	Urban			Median	23.5
4	5	Home Goods	22	4.5	Urban			Mode	#N/A
5	5	Home Goods	25	4.5	Urban			Variance	21.7666667
6	5	Home Goods	28	4.5	Urban			Range	12
7	5	Home Goods	30	4.5	Urban			Standard Deviation	4.66547604
8									
9									

The use of capturing variability



Range – A wider range means greater variability in the sales data

Variance – Reflects the overall dispersion of the data

Standard Deviation – reflects the average difference from data points to the mean

- C) Identify any potential outliers in the daily sales for each store using appropriate statistical techniques. Evaluate the impact of outliers on the overall analysis and decision-making. (4 marks)

In order to identify any potential outliers, the appropriate statistical technique would be to work out the z-score. The Z score is a measure technique that quantifies the number of standard deviations a data point is from the mean. For this the average of daily sales for all stores will need to be introduced as the null or alternative hypothesis.

Formula:

1. Mean of daily sales for store – Average daily sales for each store
2. Standard Deviation / Square Root of Number of stores
3. Z-Score = Step 1 / Step 2

Store 1 : Z-Score

[illegible]

Store 1 had an alternative hypothesis as the mean for daily sales for store 1 was not equal to the average of the daily sales for all store.

Z-Score for Store 1 = 1.32

Store 2 : Z-Score

A	B	C	D	E	F	G	H	I	J	K	L	M	N
Store	Product Category	Daily Sales (in thousands of pounds)	Average customer rating (on a scale of 1 to 5)	Location									
2	Apparel	10	3.8	Urban			Mean	15				Average Daily Sales for each store	16.9677419
2	Apparel	12	3.8	Urban			Median	15					
2	Apparel	15	3.8	Urban			Mode	#N/A				Mean - Average sales for each store	-1.9677419
2	Apparel	18	3.8	Urban			Variance	17				Standard Dev / SQRT Number of stores	1.84390889
2	Apparel	20	3.8	Urban			Range	10				Square Root Of Store	2.23606798
							Standard Deviation	4.12310563					
							Z-Score	-1.0671579					

Store 2 had an alternative hypothesis as the mean for daily sales for store 2 was not equal to the average of the daily sales for all store.

Z-Score for Store 2 = -1.07

Store 3 : Z-Score

[illegible]

Store 2 75th Percentile = 20

Store 3

[illegible]

$$0.75 \times (6+1) = 5.25$$

Store 3 75th Percentile = 16

Store 4

[illegible]

$$0.75 \times (7+1) = 6$$

Store 4 75th Percentile = 20

Store 5

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
	Store	Product Category	Daily Sales (in thousands of pounds)	Average customer rating (on a scale of 1 to 5)	Location									
1	\$	Home Goods	18	4.5	Urban			Mean	23.8333333				Average Daily Sales for each store	16.9677419
2	\$	Home Goods	20	4.5	Urban			Median	23.5					
3	\$	Home Goods	22	4.5	Urban			Mode	#N/A				Mean - Average sales for each store	6.86559143
4	\$	Home Goods	25	4.5	Urban			Variance	21.7666667				Standard Dev / SQRT Number of stores	1.90467262
5	\$	Home Goods	28	4.5	Urban			Range	12				Square Root of Store	2.44948974
6	\$	Home Goods	30	4.5	Urban			Standard Deviation	4.66547604				Total Daily Sales	143
7	6							Z-Score	-1.250319				75th Percentile Position	5.25
8								75th Percentile	28					

$$0.75 \times (6+1) = 5.25$$

Store 5 75th Percentile = 28

The 75th Percentile is significant when assessing stores performance. Its 'a good balance of representing the vast majority of measures, and not being impacted by the outliers' [1]. And provides an insight to the performance that isn't only based on average and median.

Although working with the 75th percentile indicates insights to the upper quartile of sales data, it is important to undertake a comprehensive assessment to get a full understanding of the stores performance.



- b) Identify the store(s) that perform better than the 75th percentile in each product category. (6 marks)

Electronics

Store	Product Category	Daily Sales (In thousands of pounds)	Average customer rating (on a scale of 1 to 5)	Location						
4	Electronics	5	3.6	Rural						
4	Electronics	8	3.6	Rural						
4	Electronics	10	3.6	Rural						
4	Electronics	12	3.6	Rural						
1	Electronics	12	4.2	Urban						
4	Electronics	15	3.6	Rural						
1	Electronics	15	4.2	Urban						
1	Electronics	18	4.2	Urban						
4	Electronics	20	3.6	Rural						
1	Electronics	20	4.2	Urban						
1	Electronics	20	4.2	Urban						
1	Electronics	20	4.2	Urban						
4	Electronics	22	3.6	Rural						
1	Electronics	25	4.2	Urban						
1	Electronics	28	4.2	Urban						
14										

75th Percentile 20 75th Percentile Position 11.25

With the 75th Percentile being 20, it indicates that 3 datasets of stores perform better than the 75th percentile in electronics.

Apparel

Store	Product Category	Daily Sales (In thousands of pounds)	Average customer rating (on a scale of 1 to 5)	Location						
2	Apparel	10	3.8	Urban						
2	Apparel	12	3.8	Urban						
2	Apparel	15	3.8	Urban						
2	Apparel	18	3.8	Urban						
2	Apparel	20	3.8	Urban						
5										

75th Percentile 20

75th Percentile Position 4.5

With the 75th Percentile being 20, the data shows that there are no stores performing better than the 75th percentile in Apparel.

Home Goods

	Store	Product Category	Daily Sales (in thousands of pounds)	Average customer rating (on a scale of 1 to 5)	Location															
1																				
2	3	Home Goods	8	4.1	Rural															
3	3	Home Goods	10	4.1	Rural															
4	3	Home Goods	12	4.1	Rural															
5	3	Home Goods	14	4.1	Rural															
6	3	Home Goods	16	4.1	Rural															
7	3	Home Goods	18	4.1	Rural															
8	5	Home Goods	20	4.5	Urban															
9	5	Home Goods	22	4.5	Urban															
10	5	Home Goods	25	4.5	Urban															
11	5	Home Goods	28	4.5	Urban															
12	5	Home Goods	30	4.5	Urban															
13																				
14	11																			
15																				

With the 75th percentile being 25, the data shows that there are 2 stores that perform better than the 75th percentile in Home Goods

Summary

Electronics – 3 Stores

Apparel – 0 Stores

Home Goods – 2 Stores



- c) Discuss the implications of these findings for the company's sales strategy.(8 marks)

If the business was to implement the 75th percentile they would see that the Apparel stores are not performing as well as the Electronics and Home Goods. To improve their income it would be beneficial to close the apparel stores and open more electronic stores as they are the best performers for this business in terms of income.

It could be a recommendation to close Home Goods Rural stores as they are the lowest performers within the 75th percentile in that specific store type.



B) Interpret the correlation coefficient values and discuss the strength and direction of the relationship. (6 marks)

Having a correlation coefficient of 0.74 indicates a strong and positive relationship value. This means that as one variable rises, so will the other. Overall from the correlation coefficient formula it highlights the positive relationship between the variables and implies that the data has a strong possibility of moving in the same direction.

C) Discuss the implications of these findings for the company's sales strategy. (8 marks)

Based on the finding of completing the correlation coefficient, it indicates that there is option for strategic implementations like informed decision making. Any changes within one variable will effect the other. It offers performance metrics as one variable effects the other they would only have to track one variable which could save time. And risk management. By recognising the correlation it helps in assessing risks.

In summary the implementation of correlation coefficient for this company can really help in their success as their data is positive. By introducing this it can aid and guide them to maintain their success or even take their company to the next level

Question 4:

The company wants to test whether there is a significant difference in the sales performance between two groups of stores: those located in urban areas and those in rural areas. Use the t-test to answer the following questions:

a) Formulate the null and alternative hypotheses for this test. (6 marks)

Based on the data. The null and alternative hypotheses is as follows:

Null Hypothesis

There is no significant difference in average daily sales between stores located in rural areas and stores in urban areas

Alternative Hypothesis

There is a significant difference in average daily sales between stores located in rural area and stores in urban areas

By using these hypotheses it can identify whether there is enough evidence to either accept or reject either hypothesis as the data will clearly state the outcome.

B) Conduct a t-test to evaluate the significance of the difference in daily sales between urban and rural stores. Interpret the test results, including the t-statistic, degrees of freedom, and p-value. (8 marks)

T-Test

To conduct a t-test. Firstly, the correct type of t-test needs to be chosen. For this data set and the task set, a Type II t-test will be conducted. A type II t-test is a method ' used to compare two sample means from unrelated groups ' [2]

Formula:

$$t = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\left(\frac{SD_1^2}{n_1} + \frac{SD_2^2}{n_2}\right)}}$$

Where

t = calculated t value

n = Number of items in samples

SD_1^2, SD_2^2 = Variance(square of standard deviation) of the two populations

$\bar{X}_1, \bar{X}_2$ = Mean of the two sample(group 1 and group 2)

Rural

X1 = Mean = 13.07

Standard Deviation = 5.02

n1 = Number of samples = 13

Urban

X2 = Mean = 19.78

Standard Deviation = 5.80

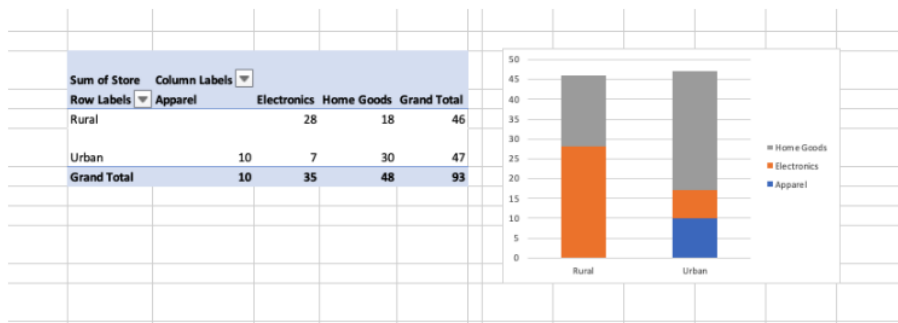
n2 = Number of samples = 18

13

$$t = \frac{13.08 - 19.78}{\sqrt{\frac{5.02^2}{13} + \frac{5.80^2}{18}}}$$

Based on the formula the data was put into the equation.

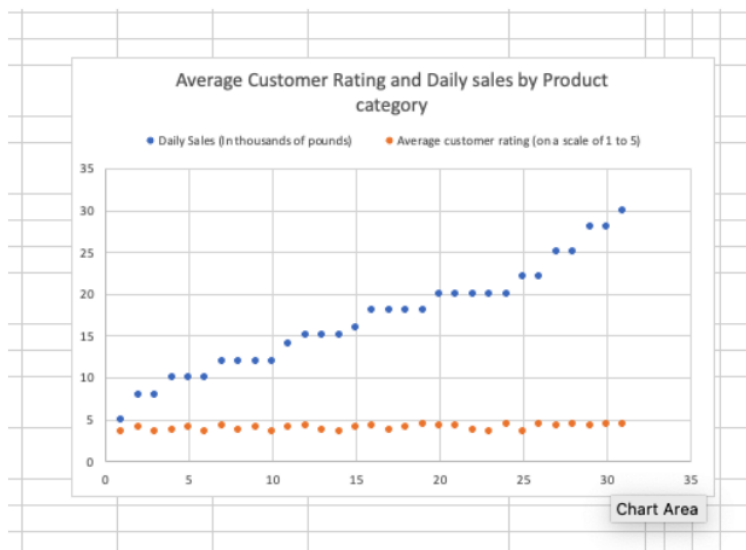
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Upon researching the most efficient way to create a stacked bar chart, it was found that “anytime using a binned categorical variable we need to use a pivot table in excel” [3] Because of the research completed, the first step was to create a pivot table in order to get numerical data from the original data.

The data from the pivot table ensured that it was possible to successfully create a stacked bar chart.

- b) Generate a scatter plot for average customer ratings on the x-axis and daily sales on the y-axis. Differentiate the data points by product category (5 marks)



Bibliography

- [1] S. Curve, "Averages, medians & percentiles," SpeedCurve,
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- [2] N. University, "Libguides: Statistics Resources: Independent Samples T-Test,"
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<https://resources.nu.edu/statsresources/IndependentSamples#:~:text=The%20independent%20samples%20t%2Dtest,are%20different%20from%20each%20other>. (accessed Jan. 7, 2024).

- [3] *How to Make STACKED Bar Charts in Excel (WK4c)*. YouTube, 2023.

Assignment 2

GRADEMARK REPORT

FINAL GRADE

GENERAL COMMENTS

78/100

Question 1	19.5
Question 2	18
Question 3	5
Question 4	17
Question 5	9.5
Writing Skills	9

PAGE 1

PAGE 2



Comment 1

A good start for a coursework

PAGE 3

PAGE 4

PAGE 5



Comment 2

well explained

PAGE 6

PAGE 7



Comment 3

These measures help in understanding the dispersion of sales values around the mean



Comment 4

reasons for the decision could be emphasized



Comment 5

Q3 values for daily sales in each store provide actionable insights for tailoring the company's sales strategy.



Comment 6

It's the same store (store 5) but varies based on daily sales



Comment 7

possible solution: Consider diversifying product offerings or implementing targeted promotions



Comment 8

wrong interpretaion has been done. this will affect the N value and also the mean. co relation should have been found with the exact values



Comment 9

.

A correlation coefficient of 0.56 suggests a moderate positive correlation between daily sales and average customer ratings.



Comment 10

uniform formatting styles should be followed



Comment 11

Continuous monitoring, adaptation, and responsiveness to customer feedback will be key to sustaining and enhancing both customer satisfaction and sales performance.



Comment 12

well done

PAGE 16



Comment 13

thoughtful process. good job

PAGE 17



Comment 14

possible actions?

Example: Fine-tune inventory management practices to avoid stockouts or overstock situations based on the demand patterns in rural and urban stores .

PAGE 18

PAGE 19
