Introduction to Machine Learning Assignment 2

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Question 1 Answer:

The lift of an association rule {Cheese, Wing} => {Soda} can be calculated as follows:

Lift({Cheese, Wing} => {Soda}) = (P({Cheese, Wing} => {Soda}) / (P({Cheese, Wing}) * P({Soda})))

P({Cheese, Wing}) = 4/6
P({Soda}) = 4/6
P({Cheese, Wing} => {Soda}) = 2/6

Lift({Cheese, Wing} => {Soda}) = (2/6) / (4/6 * 4/6) = 0.75

So the lift of the association rule {Cheese, Wing} => {Soda} is 0.75, which means that the presence of Cheese and Wing in a transaction prohibits the likelihood of having Soda by 0.75 times compared to the likelihood of having Soda if Cheese and Wing were not present.

Question 2 Answers:

a) (The Python code for this is in the file: 2_a.py)

Output Screenshot :

```
Number of items in the Universal Set: 169
Maximum number of itemsets: 748288838313422294120286634350736906063837462003711
Maximum number of association rules: 430023359390034222082732011946860220634520402626757122001337339969404822623413860
```

Answer:

Number of items in the Universal Set: **169**
Maximum number of itemsets:
748288838313422294120286634350736906063837462003711
Maximum number of association rules:
430023359390034222082732011946860220634520402626757122001337339969404822623413860

b) (The Python code for this is in the file: 2_b.py)

Output Screenshot :

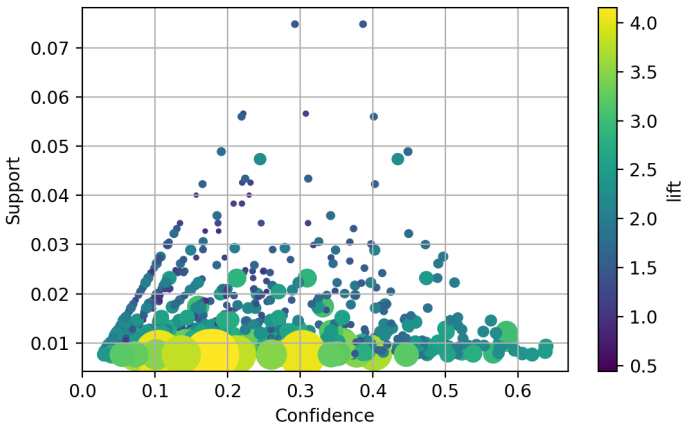
```
Number of itemsets found: 524
Largest number of items among the itemsets: 4
```

Answer:

Number of itemsets found: 524
Largest number of items among the itemsets: 4

c) (The Python code for this is in the file: 2_c.py)

Plot :



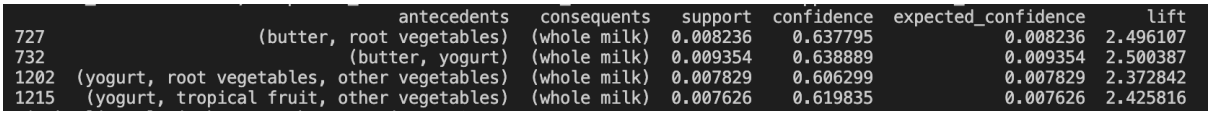
Output Screenshot:

Answer:

Number of Association Rules : 1228

d) (The Python code for this is in the file: 2_d.py)

Output Screenshot:



	antecedents	consequents	support	confidence	expected_confidence	lift
727	(butter, root vegetables)	(whole milk)	0.008236	0.637795	0.008236	2.496107
732	(butter, yogurt)	(whole milk)	0.009354	0.638889	0.009354	2.500387
1202	(yogurt, root vegetables, other vegetables)	(whole milk)	0.007829	0.606299	0.007829	2.372842
1215	(yogurt, tropical fruit, other vegetables)	(whole milk)	0.007626	0.619835	0.007626	2.425816

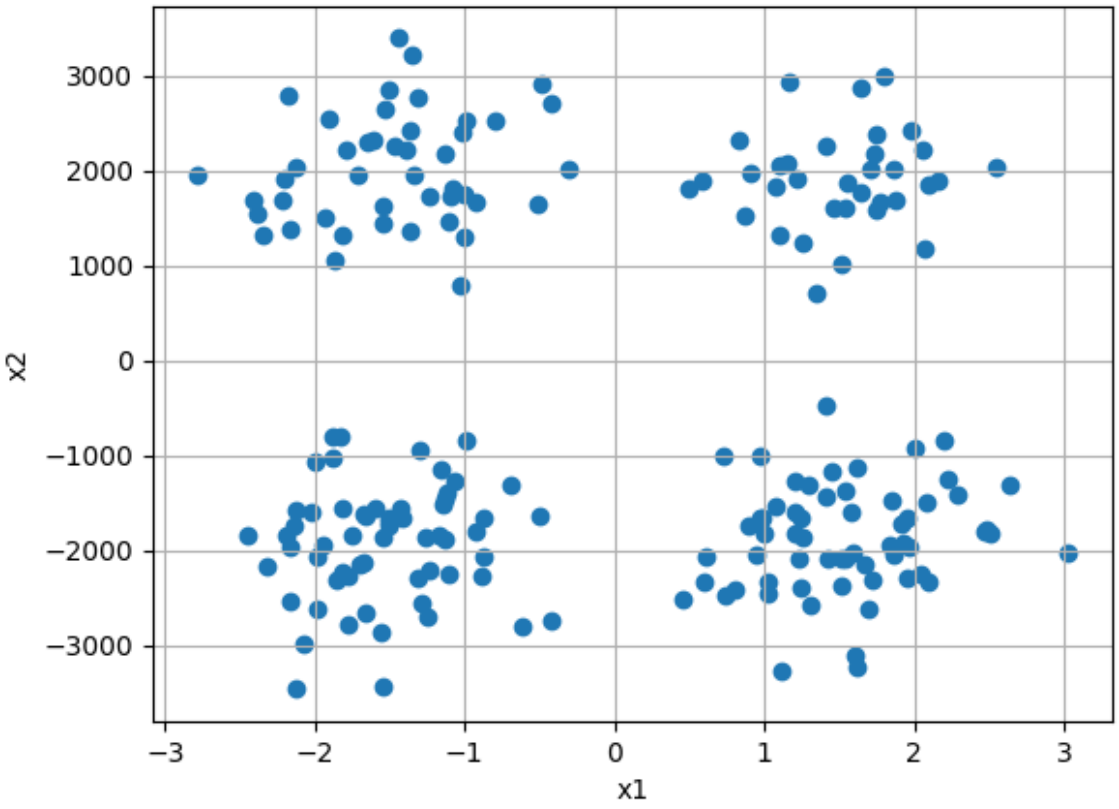
Answer:

antecedents	consequents	support	confidence	expected_confidence	lift
frozenset({'butter', 'root vegetables'})	frozenset({'whole milk'})	0.008235892221657347	0.6377952755905512	0.008235892221657347	2.4961068585089814
frozenset({'yogurt', 'butter'})	frozenset({'whole milk'})	0.009354346720894764	0.6388888888888888	0.009354346720894764	2.5003868777127824
frozenset({'other vegetables', 'yogurt', 'root vegetables'})	frozenset({'whole milk'})	0.007829181494661922	0.6062992125984252	0.007829181494661922	2.3728423222863158
frozenset({'other vegetables', 'tropical fruit', 'yogurt'})	frozenset({'whole milk'})	0.007625826131164209	0.6198347107438016	0.007625826131164209	2.4258155114068

Question 3 Answers:

a) The Python code for this is in the file: 3_a.py)

Plot :



Answer :

After plotting the graph for the given csv file data. We can see **4** Clusters.

b) (The Python code for this is in the file: 3_b.py)

Plot:

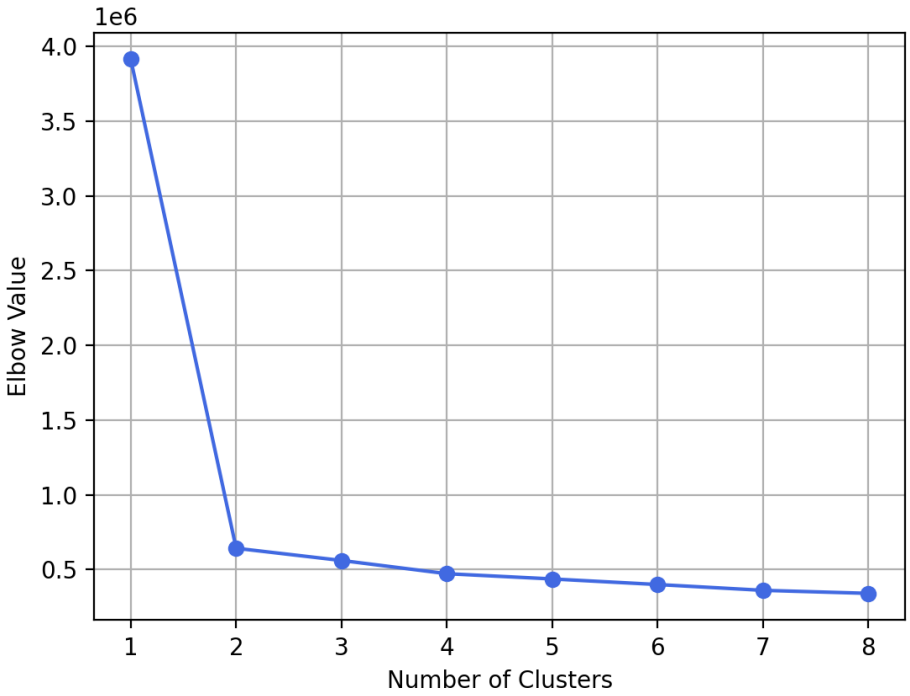


Table:

N Cluster	Total WCSS	Elbow
1	782891013.0238838	3914455.0651194192
2	65089654.389735684	642801.0914895514
3	39336456.73787262	561190.5233420159
4	23904953.907457363	472686.29825282836
5	16753104.001151742	437484.9906273829
6	12920965.175807077	400209.84188469034
7	8955639.98858235	361367.06280921295
8	7101906.903299999	341090.52933626255

Answer:

The Optimal number of clusters with the given elbow values is: **2**
The Centroids of two cluster are: (x1,y1) (x2,y2) are the centroids

X1 = -0.194810 Y1 = 1967.883544
X2 = 0.014711 Y2 = -1905.196694

c) (The Python code for this is in the file: 3_c.py)

Plot:

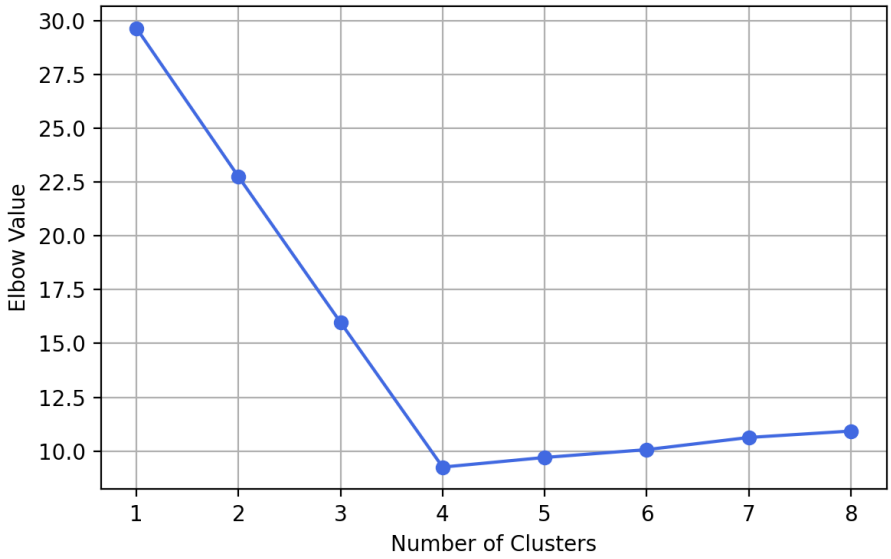


Table:

N Cluster	Total WCSS	Elbow
1	5929.373746784754	29.64686873392377
2	2294.06353363172	22.74379295479966
3	1148.4589604208093	15.972892359357436
4	472.7690931119309	9.254667350391188
5	414.54248827566096	9.702143737199108
6	355.11013827238946	10.066034160723163
7	307.2879592054128	10.631243336329957
8	284.45993478786687	10.928476843346912

Answer:

The Optimal number of clusters with the given elbow values is: **4**
The Centroids of two cluster are:

0	**2.260023**	**7.994898**
1	**2.172680**	**2.237297**
2	**7.422117**	**2.313790**
3	**7.369618**	**7.826083**
	x1	**x2**

d) Answer:

Prior to performing rescaling on the input variables, the optimal number of clusters was determined to be **2** based on the elbow value obtained through the analysis. However, upon applying the rescaling technique, the optimal number of clusters increased to **4**.

Prior to the rescaling, when visualizing the untouched TwoFeatures.csv data (3_a.py), **4** clusters appeared to be an optimal solution. However, due to differences in the range and scale of x1 and x2, K-Means may have been giving more weight to one variable over the other, causing suboptimal clustering results. The rescaling of input variables allows for equal weighting of each variable, ultimately enabling K-Means to identify clusters based on both variables in an equitable manner.

Therefore, based on the above analysis, the optimal number of clusters for this particular dataset would be **4**.