3. Evaluation

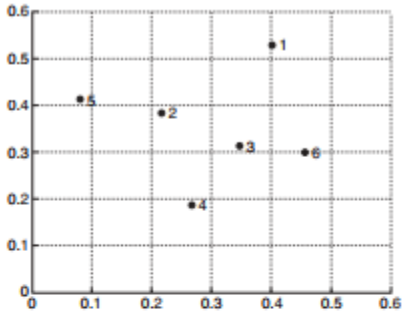


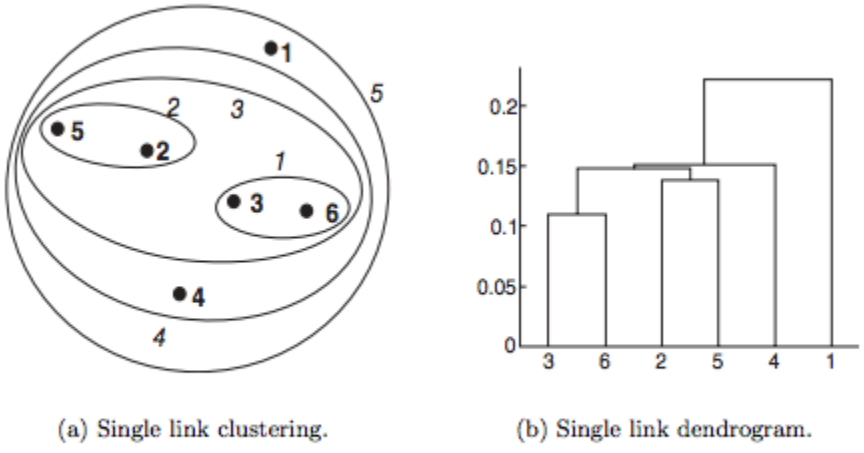
Figure 8.15. Set of 6 two-dimensional points.

Point	x Coordinate	y Coordinate
p1	0.40	0.53
p2	0.22	0.38
p3	0.35	0.32
p4	0.26	0.19
p5	0.08	0.41
p6	0.45	0.30

Table 8.3. xy coordinates of 6 points.

	p1	p2	p3	p4	p5	p6
p1	0.00	0.24	0.22	0.37	0.34	0.23
p2	0.24	0.00	0.15	0.20	0.14	0.25
p3	0.22	0.15	0.00	0.15	0.28	0.11
p4	0.37	0.20	0.15	0.00	0.29	0.22
p5	0.34	0.14	0.28	0.29	0.00	0.39
p6	0.23	0.25	0.11	0.22	0.39	0.00

Table 8.4. Euclidean distance matrix for 6 points.



(a) Single link clustering.

(b) Single link dendrogram.

Figure 8.16. Single link clustering of the six points shown in Figure 8.15.

Table 8.7. Cophenetic distance matrix for single link and data in table 8.3

Point	P1	P2	P3	P4	P5	P6
P1	0	0.222	0.222	0.222	0.222	0.222
P2	0.222	0	0.148	0.151	0.139	0.148
P3	0.222	0.148	0	0.151	0.148	0.110
P4	0.222	0.151	0.151	0	0.151	0.151
P5	0.222	0.139	0.148	0.151	0	0.148
P6	0.222	0.148	0.110	0.151	0.148	0

3.1 Cophenetic Correlation Coefficient

a. Examine Table 8.7 in the TSK text. Explain how the following cells of the table were computed: P3/P6, P2/P5, P3/P5, P2/P6.

Solution:

The distance table is provided in Table 8.4

P3/P6 = dist({3, 6}) = 0.11

P2/P5 = dist({2, 5}) = 0.139

P3/P5 = dist({3, 5}) = min(dist(3, 2), dist(6, 5), dist(6, 2), dist(3, 5) = min(0.148, 0.39, 0.25, 0.28) = 0.148

P2/P6 = dist({2, 6}) = min(dist(3, 2), dist(6, 5), dist(6, 2), dist(3, 5) = min(0.148, 0.39, 0.25, 0.28) = 0.148

b. Based upon Tables 8.4 and 8.7, show all work to compute the Cophenetic Correlation Coefficient. (Note that individual additions/subtractions are not necessary, but results of sums and products are – make sure to demonstrate the process.)

Solution:

Distance	CP	(x- Mu_x)	(y-Mu_y)	(x-Mu_x)^2	(y-Mu_y)^2
0.24	0.222	0	0.052	0	0.002704
0.22	0.222	-0.02	0.052	0.0004	0.002704
0.37	0.222	0.13	0.052	0.0169	0.002704
0.34	0.222	0.1	0.052	0.01	0.002704
0.23	0.222	-0.01	0.052	1E-04	0.002704
0.15	0.148	-0.09	-0.022	0.0081	0.000484
0.2	0.151	-0.04	-0.019	0.0016	0.000361
0.14	0.139	-0.1	-0.031	0.01	0.000961
0.25	0.148	0.01	-0.022	0.0001	0.000484
0.15	0.151	-0.09	-0.019	0.0081	0.000361
0.28	0.148	0.04	-0.022	0.0016	0.000484
0.11	0.11	-0.13	-0.06	0.0169	0.0036
0.29	0.151	0.05	-0.019	0.0025	0.000361
0.22	0.151	-0.02	-0.019	0.0004	0.000361

0.39	0.148	0.15	-0.022	0.0225	0.000484

Mu_x = avg(distance) = 0.2387
Mu_y = avg(CP) = 0.1703

Covariance(distance, CP) = 0.00148
Stddev(distance) = 0.0842
Stddev(CP) = 0.0392

Single link = Stddev(distance) * Stddev(CP) / Covariance(distance, CP) = 0.45

3.2 Purity

Table 8.9. K-means clustering results for the *LA Times* document data set.

Cluster	Enter-tainment	Financial	Foreign	Metro	National	Sports	Entropy	Purity
1	3	5	40	506	96	27	1.2270	0.7474
2	4	7	280	29	39	2	1.1472	0.7756
3	1	1	1	7	4	671	0.1813	0.9796
4	10	162	3	119	73	2	1.7487	0.4390
5	331	22	5	70	13	23	1.3976	0.7134
6	5	358	12	212	48	13	1.5523	0.5525
Total	354	555	341	943	273	738	1.1450	0.7203

While not robust to increasing K, purity is a simple measure accounting for the extent to which clusters contain a single class.

a. Examine Table 8.9 in the TSK text. Show each step to compute the values in the Purity column of the table.

Solution:

To calculate Purity: Loop through each cluster (LA Times document). Then for each cluster, select the maximum value from each row, sum them together and finally divide by the total number of data points

For example: for cluster 1

506/(3+5+40+506+96+27=677) = 0.7474

2: 280/361 = 0.7756

3: 671/685 = 0.9796

4: 162/369 = 0.4390

5: 331/464 = 0.7134

6: 358/648 = 0.5525

b. Based upon the purity metric, is this a good clustering? Which of the clusters is particularly good via this metric – provide a reasonable explanation as to why this might be true.

Solution:
Not really, as you can see from the purity value, most of them is about 0.7. Cluster 3 is good though because it's mostly sports.