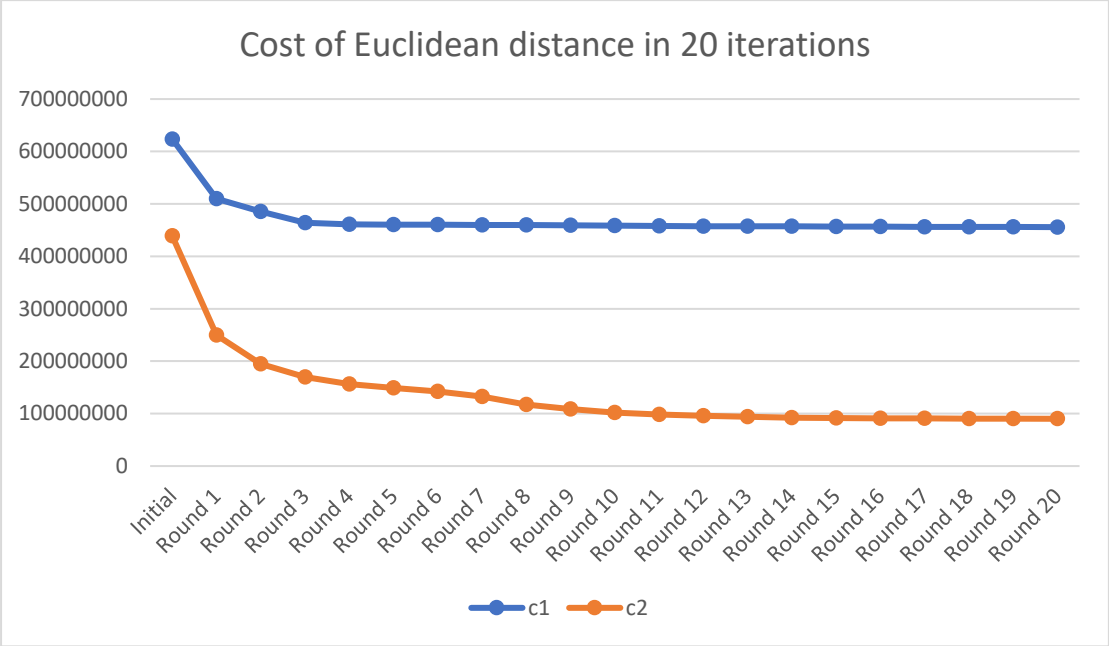
(a)

1. A plot of cost vs. iteration for 2 initialization strategies(c1 and c2)



2. Percentage improvement values formula :

$$\frac{|Cost_{i=20} - Cost_{i=1}| * 100\%}{Cost_{i=1}}$$

C1 = $\frac{|455729268.36 - 623660345.31|}{623660345.31} * 100\% = 26.93\%$

C2 = $\frac{|90162390.91 - 438747790.03|}{438747790.03} * 100\% = 79.45\%$

Explanation :可以看出 c2 的 percentage improvement 比較好，我認為是因為 c1 是 random 的群中心，群中心之間相較於 c2，越有機會找到鄰近的點，導致原本可能為同一個 cluster 的點，被迫分成兩個群，以至結果不佳，cost 居高不下，由於 c2 是每次取與已生成的群中心最遠的點為新的群中心，故發生上述情況的機率較小，cluster 的結果較好。

3. Distance between Centroids

(1) Euclidean strategy + C1 + Euclidean distance computing

	1	2	3	4	5	6	7	8	9	10
1	0.0	692.16	3490.26	205.75	346.72	512.61	444.73	566.2	1282.77	307.67
2		0.0	2798.8	897.66	1038.83	1204.08	1136.33	1257.45	669.89	412.08
3			0.0	3695.11	3836.91	4002.69	3934.87	4056.14	2294.58	3195.92
4				0.0	142.44	309.51	241.73	363.26	1474.95	504.63
5					0.0	167.15	99.55	220.9	1615.85	646.93
6						0.0	67.91	53.79	1782.2	814.08

7							0.0	121.63	1715.25	746.34
8								0.0	1835.64	867.82
9									0.0	975.32
10										0.0

(2) Euclidean strategy + C1 + Manhattan distance computing

	1	2	3	4	5	6	7	8	9	10
1	0.0	728.92	3797.9	212.18	374.89	577.4	499.16	645.77	1731.06	406.7
2		0.0	3072.89	935.89	1100.83	1303.9	1225.35	1372.09	1005.29	490.93
3			0.0	4001.04	4170.3	4372.79	4294.95	4440.72	2513.42	3396.42
4				0.0	171.37	375.25	296.25	443.5	1934.09	609.75
5					0.0	204.52	125.6	272.93	2102.86	779.4
6						0.0	79.4	69.59	2306.38	983.02
7							0.0	147.87	2227.56	904.37
8								0.0	2374.55	1050.92
9									0.0	1327.58
10										0.0

(3) Euclidean strategy + C2 + Euclidean distance computing

	1	2	3	4	5	6	7	8	9	10
1	0.0	15760.12	14100.83	9045.32	5567.68	1924.62	1100.86	402.89	2105.44	3169.0
2		0.0	11524.51	6743.88	10192.53	14455.12	14682.45	15362.42	13674.71	12597.04
3			0.0	9545.88	10883.38	12233.96	13208.0	13786.48	12508.96	11938.38
4				0.0	3494.22	7718.22	7957.78	8644.81	6947.82	5876.33
5					0.0	4404.56	4492.46	5169.94	3488.16	2407.92
6						0.0	1182.86	1615.79	1313.33	2153.77
7							0.0	698.49	1010.2	2085.46
8								0.0	1702.79	2768.61
9									0.0	1080.53
10										0.0

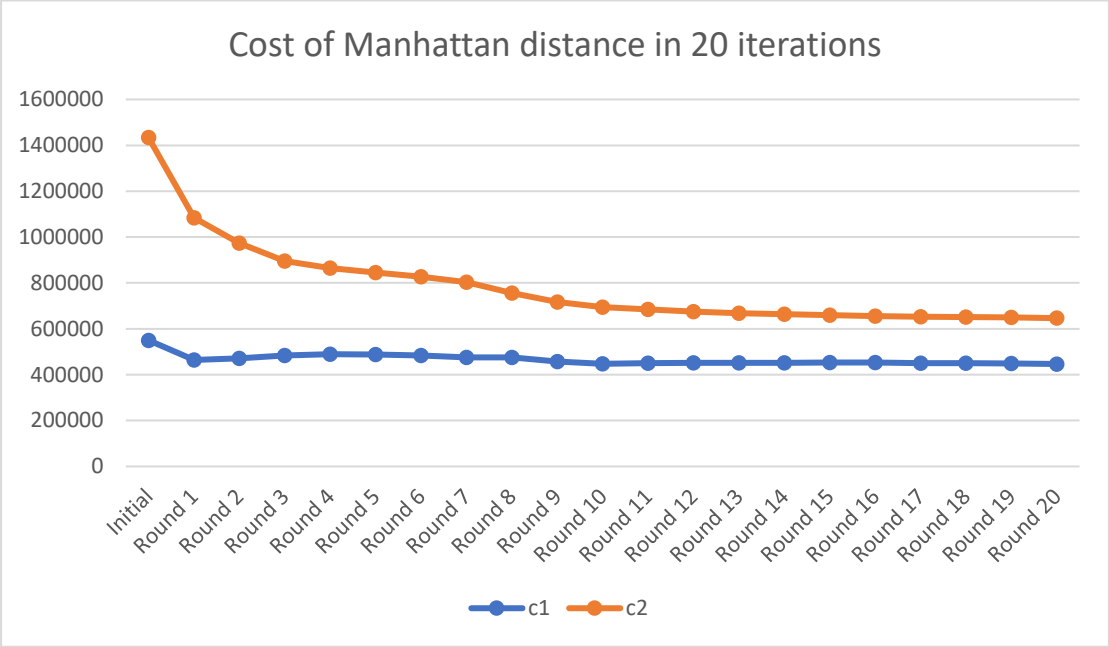
(4) Euclidean strategy + C2 + Manhattan distance computing

	1	2	3	4	5	6	7	8	9	10
1	0.0	15772.61	20215.65	9533.17	5604.2	3088.05	1311.04	471.27	2369.41	3349.66
2		0.0	16003.5	7219.2	10221.03	16105.35	14909.17	15434.46	13950.58	12776.88
3			0.0	10690.48	14613.55	17509.9	18912.61	19748.94	17851.81	16873.24
4				0.0	3935.29	8896.39	8228.36	9065.4	7168.73	6190.68
5					0.0	5893.07	4696.98	5221.25	3737.71	2564.17
6						0.0	1781.82	2619.81	2162.8	3337.75
7							0.0	840.72	1068.94	2137.79

8								0.0	1901.21	2883.73
9									0.0	1176.45
10										0.0

(b)

1. A plot of cost vs. iteration for 2 initialization strategies(c1 and c2)



$$\frac{|Cost_{i=20} - Cost_{i=1}|}{Cost_{i=1}} * 100\%$$

2. Percentage improvement values formula :

C1 = $\frac{|446770.42 - 550117.14|}{550117.14} * 100\%$ = 18.79%

C2 = $\frac{|646481.16 - 1433739.31|}{1433739.31} * 100\%$ = 54.91%

Explanation：同(a)2.，在兩種 distance 計算方式中，皆可以看出 c2 的 percentage improvement 比較好，我認為是因為 c1 是 random 的群中心，群中心之間相較於 c2，越有機會找到鄰近的點，導致原本可能為同一個 cluster 的點，被迫分成兩個群，以至結果不佳，cost 居高不下，由於 c2 是每次取與已生成的群中心最遠的點為新的群中心，故發生上述情況的機率較小，cluster 的結果較好。

3. Distance between Centroids

(1) Manhattan strategy + C1 + Euclidean distance computing

	1	2	3	4	5	6	7	8	9	10
1	0.0	2219.18	9948.04	528.7	413.37	827.72	681.03	917.13	832.15	729.06
2		0.0	7767.95	2734.05	2628.49	3044.48	2898.71	3133.46	1812.45	1491.36

3			0.0	10433.06	10361.37	10733.53	10626.49	10862.97	9340.28	9236.84
4				0.0	221.37	375.16	249.38	457.26	1156.58	1251.16
5					0.0	415.99	270.75	505.07	1171.96	1137.14
6						0.0	147.05	89.49	1529.46	1553.12
7							0.0	236.51	1391.55	1407.4
8								0.0	1613.56	1642.13
9									0.0	709.41
10										0.0

(2) Manhattan strategy + C1 + Manhattan distance computing

	1	2	3	4	5	6	7	8	9	10
1	0.0	2341.02	11929.3	651.19	496.33	947.74	770.74	1056.8	1260.51	737.71
2		0.0	9597.44	2778.95	2830.14	3280.36	3104.29	3388.98	2380.46	1605.27
3			0.0	12323.29	12421.26	12871.48	12695.55	12979.13	10775.94	11196.79
4				0.0	335.95	558.47	382.46	667.53	1653.83	1379.17
5					0.0	452.86	276.33	561.85	1755.11	1226.66
6						0.0	177.59	110.22	2205.31	1677.67
7							0.0	287.43	2028.9	1500.99
8								0.0	2314.67	1786.81
9									0.0	1006.37
10										0.0

(3) Manhattan strategy + C2 + Euclidean distance computing

	1	2	3	4	5	6	7	8	9	10
1	0.0	15747.23	14100.14	9032.33	5554.79	2006.7	1338.16	514.63	1571.24	3022.66
2		0.0	11524.51	6743.88	10192.53	14474.55	14412.06	15239.88	14328.23	12731.4
3			0.0	9545.88	10883.38	12167.79	13125.35	13684.61	12643.99	12006.39
4				0.0	3494.22	7742.63	7694.28	8521.2	7588.4	6009.82
5					0.0	4452.97	4219.76	5047.52	4167.64	2542.57
6						0.0	1405.11	1637.73	910.99	2124.26
7							0.0	827.84	566.55	1684.52
8								0.0	1081.38	2511.46
9									0.0	1649.39
10										0.0

(4) Manhattan strategy + C2 + Manhattan distance computing

	1	2	3	4	5	6	7	8	9	10
1	0.0	15757.69	20200.26	9517.67	5588.85	3281.49	1430.21	602.95	2102.55	3211.46
2		0.0	16003.5	7219.2	10221.03	16325.27	14506.49	15335.96	14980.06	12922.93
3			0.0	10690.48	14613.55	17521.52	18775.12	19602.26	18111.89	16995.13

4				0.0	3935.29	9116.02	8090.51	8918.81	7771.22	6312.53
5					0.0	6110.83	4293.5	5123.07	4768.92	2710.06
6						0.0	1855.58	2682.57	1358.8	3413.04
7							0.0	833.43	674.83	1784.51
8								0.0	1500.82	2614.0
9									0.0	2062.25
10										0.0