台中西屯 PM 2.5 監測

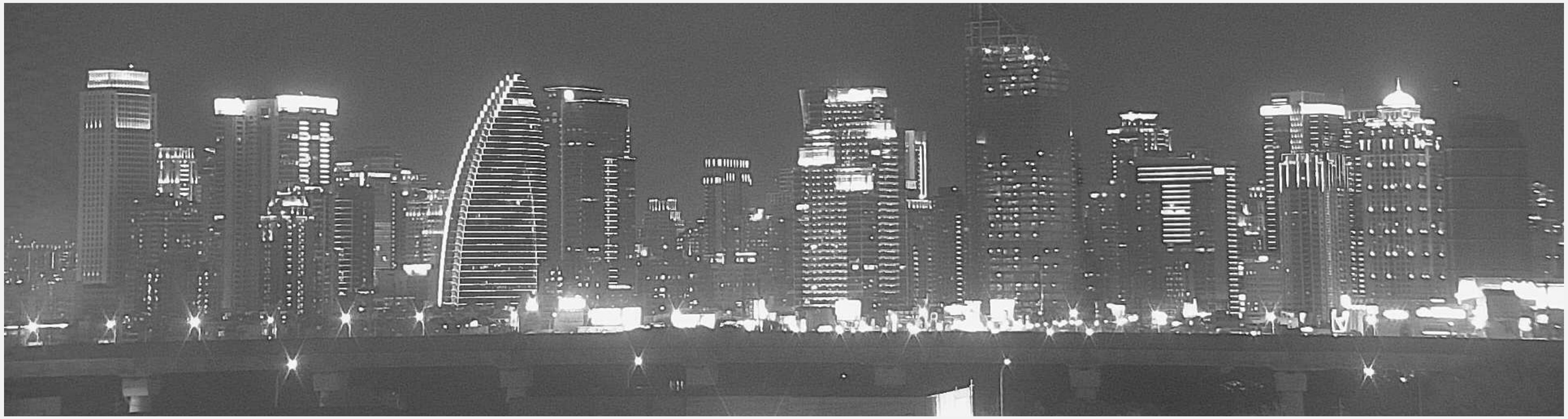


Table Of Content

Data Set

日期	17	18	19	20	21
2023-10-01	9	10	14	10	11
2023-10-02	13	15	15	10	7
2023-10-03	21	11	7	9	12
2023-10-04	4	11	9	10	11
2023-10-05	14	18	26	28	26
2023-10-06	19	14	10	14	17
2023-10-07	7	8	8	4	2
2023-10-08	11	7	10	8	7
2023-10-09	5	10	13	9	8
2023-10-10	15	11	11	11	7
2023-10-11	14	12	8	8	10
2023-10-12	13	11	10	11	16
2023-10-13	14	12	16	16	13
2023-10-14	17	26	28	24	19
2023-10-15	28	25	28	28	21

日期	17	18	19	20	21
2023-10-16	27	24	29	24	25
2023-10-17	30	35	38	34	37
2023-10-18	26	30	34	38	42
2023-10-19	41	40	57	43	37
2023-10-20	8	3	4	10	9
2023-10-21	7	9	12	11	6
2023-10-22	10	16	9	10	9
2023-10-23	15	17	22	20	18
2023-10-24	24	21	24	21	23
2023-10-25	19	17	18	14	15
2023-10-26	27	25	38	44	55
2023-10-27	17	19	23	18	19
2023-10-28	19	18	13	16	14
2023-10-29	12	10	10	14	14
2023-10-30	13	14	12	10	10
2023-10-31	12	14	9	9	11

來源 : https://airtw.moenv.gov.tw/CHT/Query/InsValue.aspx

c chart

Step 1 將蒐集到的資料取平均 = 17.14

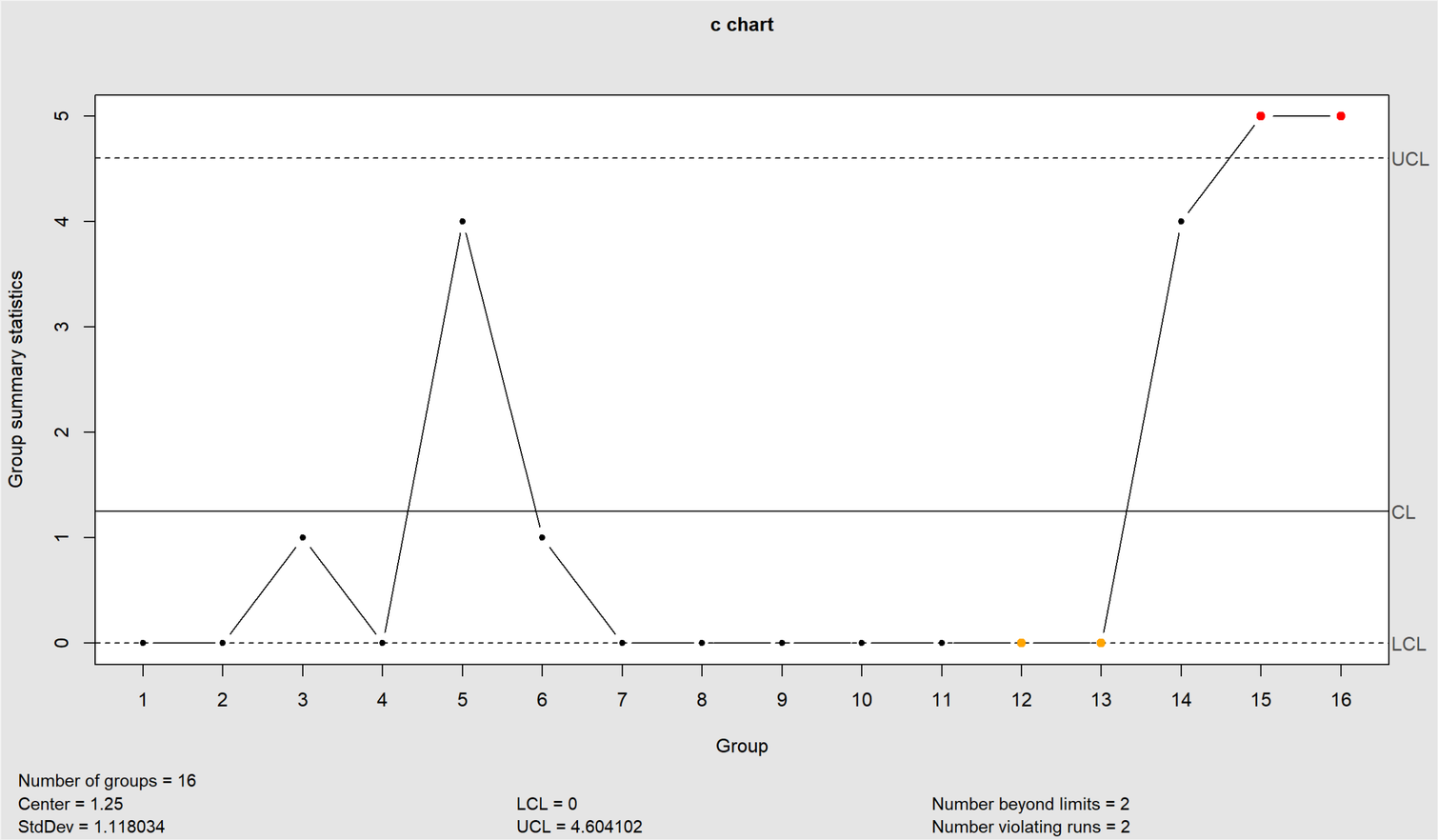
Step 2 設定不良和良的方式 - 大於平均值設為1（不良）

- 小於平均值設為0（良）

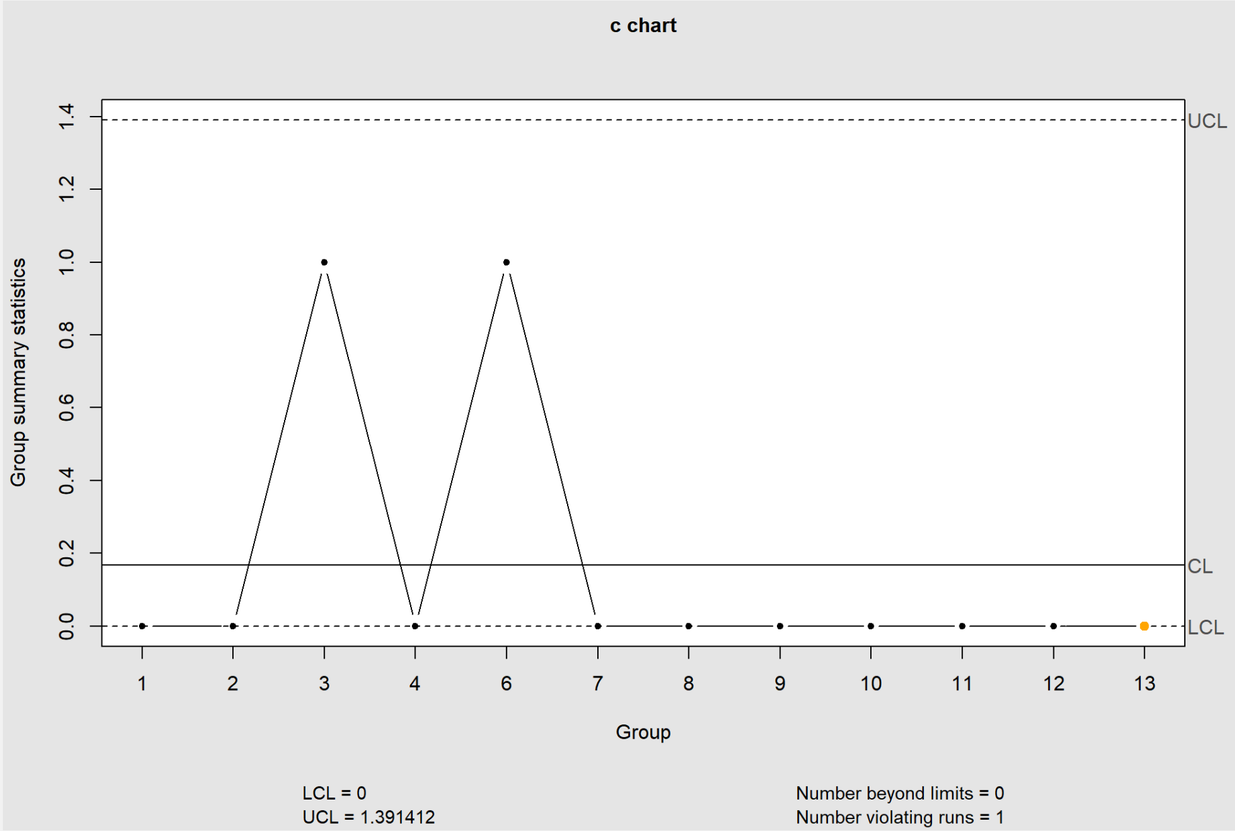
並計算每個樣本不良之個數

日期	17	18	19	20	21	Count
2023-10-01	0	0	0	0	0	0
2023-10-02	0	0	0	0	0	0
2023-10-03	1	0	0	0	0	1
2023-10-04	0	0	0	0	0	0
2023-10-05	0	1	1	1	1	4
2023-10-06	1	0	0	0	0	1
2023-10-07	0	0	0	0	0	0
2023-10-08	0	0	0	0	0	0
2023-10-09	0	0	0	0	0	0

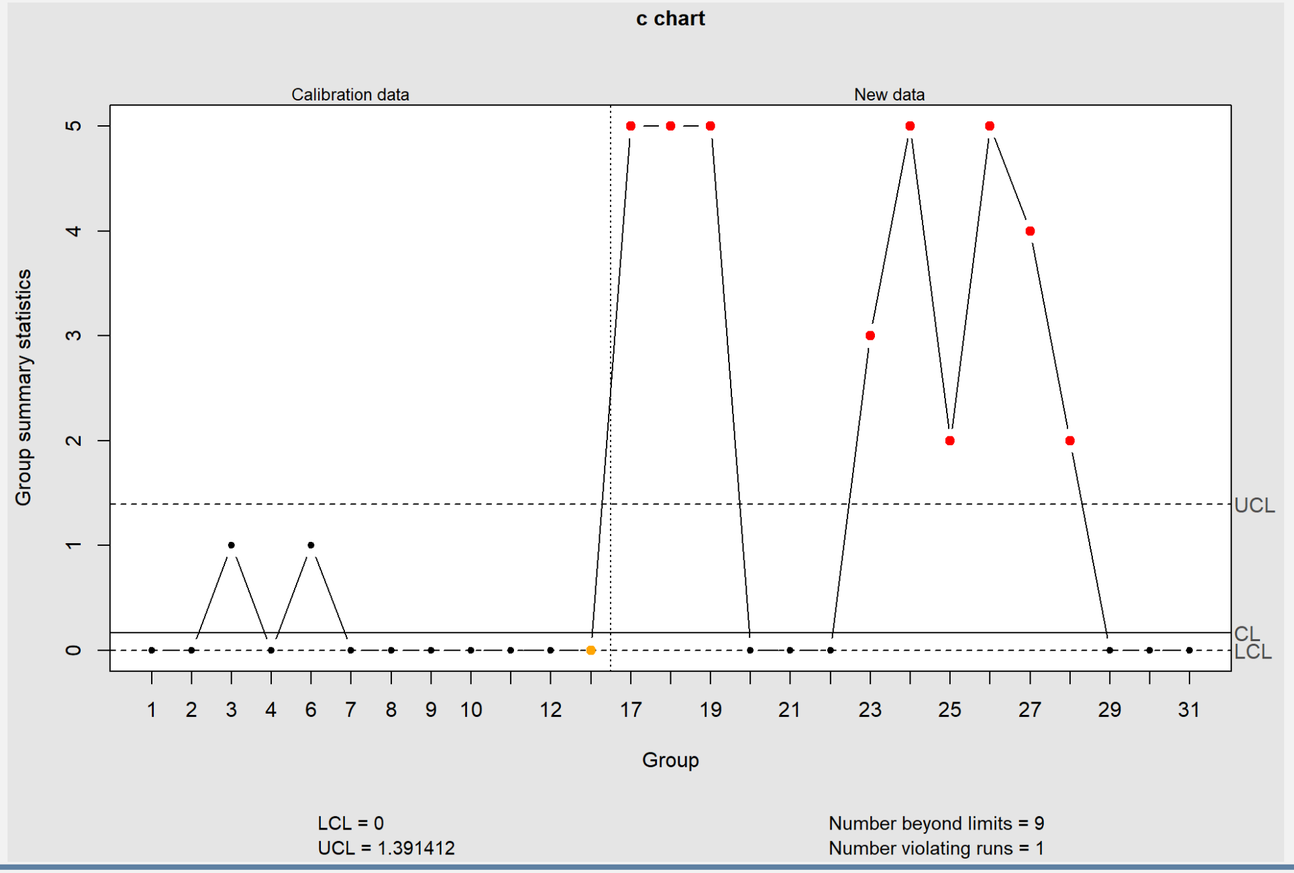
Step 4 (phase 1)製作管制圖



Step 5 移除 out-of-control 之值並重製 c chart



Step 6 (phase 2)放入管制圖檢驗



CUSUM

Step 1 將每個樣本內17-21時值取平均並計算樣本平均及標準差

日期	17	18	19	20	21	average
2023-10-01	9	10	14	10	11	10.8
2023-10-02	13	15	15	10	7	12
2023-10-03	21	11	7	9	12	12
2023-10-04	4	11	9	10	11	9
2023-10-05	14	18	26	28	26	22.4
2023-10-06	19	14	10	14	17	14.8
2023-10-07	7	8	8	4	2	5.8
2023-10-08	11	7	10	8	7	8.6
2023-10-09	5	10	13	9	8	9
2023-10-10	15	11	11	11	7	11
2023-10-11	14	12	8	8	10	10.4
2023-10-12	13	11	10	11	16	12.2
2023-10-13	14	12	16	16	13	14.2
2023-10-14	17	26	28	24	19	22.8
2023-10-15	28	25	28	28	21	26
2023-10-16	27	24	29	24	25	25.8
2023-10-17	30	35	38	34	37	34.8
2023-10-18	26	30	34	38	42	34
2023-10-19	41	40	57	43	37	43.6
2023-10-20	8	3	4	10	9	6.8
2023-10-21	7	9	12	11	6	9

$\bar{x}$ = 17.135

s = 9.71

Step 2 製作 CUSUM 表格

$$c_i^+ = max[0, x_i - (17.135 + 0.5) + c_{i-1}^+]$$

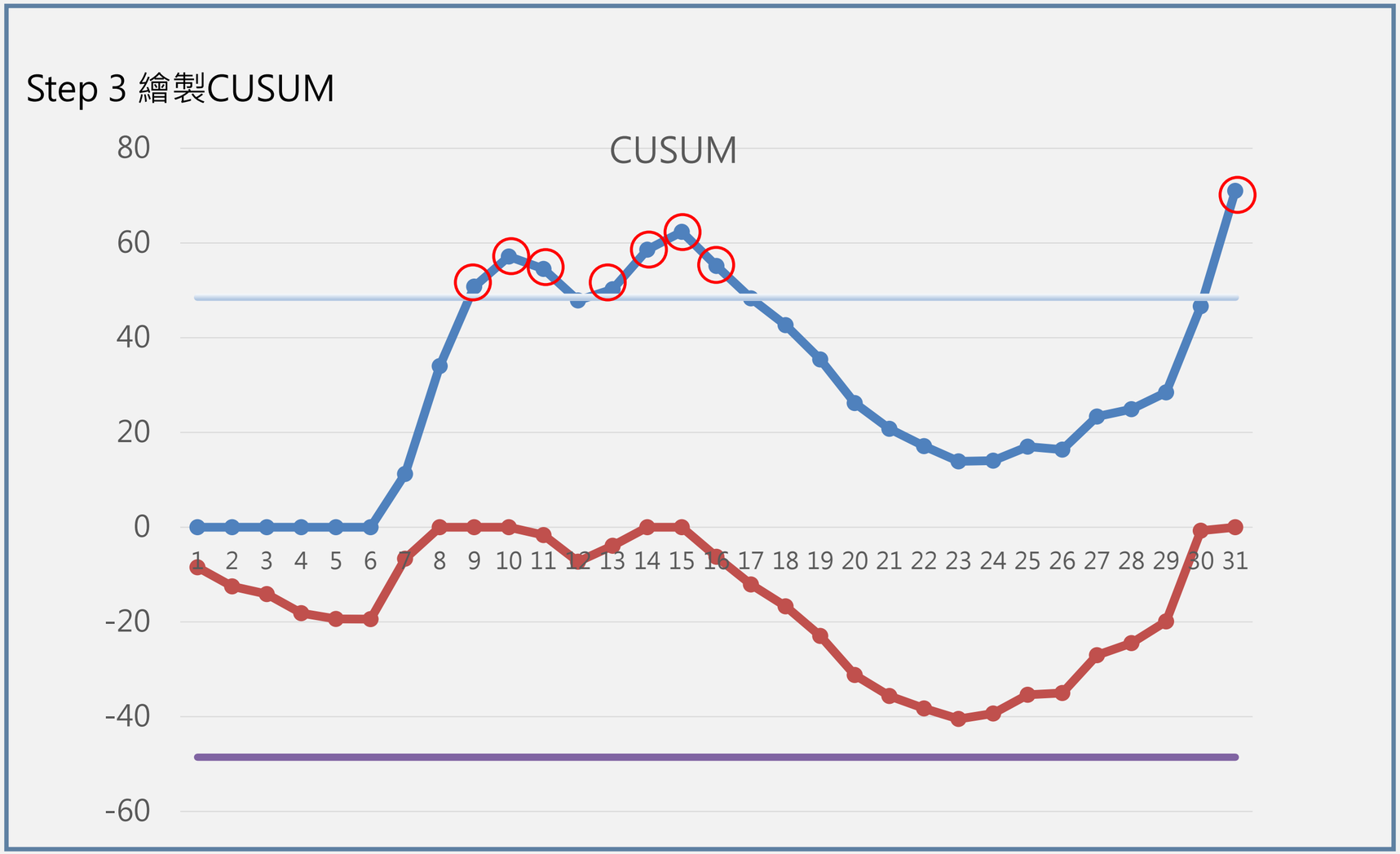
$$c_i^- = max[0, (17.135 - 0.5) - x_i + c_{i-1}^+]$$

out-of-control

$$c_i^+ > 5 \cdot 9.71 = 48.55 \ \ or \ \ c_i^- < 5 \cdot 9.71 = 48.55$$

period	x_i	(a)			(b)		
		x_i -17.635	c_i^+	N^+	16.635 - xi	c_i^-	N-
1	8.2	-9.435	0	0	8.435	8.435	1
2	12.6	-5.035	0	0	4.035	12.47	2
3	15	-2.635	0	0	1.635	14.105	3
4	12.6	-5.035	0	0	4.035	18.14	4
5	15.4	-2.235	0	0	1.235	19.375	5
6	16.6	-1.035	0	0	0.035	19.41	6
7	29.4	11.765	11.265	1	-12.765	6.645	7
8	40.4	22.765	34.03	2	-23.765	0	0
9	34.4	16.765	50.795	3	-17.765	0	0
10	24	6.365	57.16	4	-7.365	0	0
11	15	-2.635	54.525	5	1.635	1.635	1
12	11	-6.635	47.89	6	5.635	7.27	2
13	20	2.365	50.255	7	-3.365	3.905	3
14	26	8.365	58.62	8	-9.365	0	0
15	21.4	3.765	62.385	9	-4.765	0	0
16	10.4	-7.235	55.15	10	6.235	6.235	1
17	10.8	-6.835	48.315	11	5.835	12.07	2
18	12	-5.635	42.68	12	4.635	16.705	3
19	10.4	-7.235	35.445	13	6.235	22.94	4
20	8.4	-9.235	26.21	14	8.235	31.175	5
21	12.2	-5.435	20.775	15	4.435	35.61	6
22	14	-3.635	17.14	16	2.635	38.245	7
23	14.4	-3.235	13.905	17	2.235	40.48	8
24	17.8	0.165	14.07	18	-1.165	39.315	9
25	20.6	2.965	17.035	19	-3.965	35.35	10
26	17	-0.635	16.4	20	-0.365	34.985	11
27	24.6	6.965	23.365	21	-7.965	27.02	12
28	19.2	1.565	24.93	22	-2.565	24.455	13
29	21.2	3.565	28.495	23	-4.565	19.89	14
30	35.8	18.165	46.66	24	-19.165	0.725	0
31	42	24.365	71.025	25	-25.365	0	0

Step 3 繪製CUSUM



EWMA

Step 1將每個樣本內17-21時值取平均並計算樣本平均及標準差

日期	17	18	19	20	21	average
2023-10-01	9	10	14	10	11	10.8
2023-10-02	13	15	15	10	7	12
2023-10-03	21	11	7	9	12	12
2023-10-04	4	11	9	10	11	9
2023-10-05	14	18	26	28	26	22.4
2023-10-06	19	14	10	14	17	14.8
2023-10-07	7	8	8	4	2	5.8
2023-10-08	11	7	10	8	7	8.6
2023-10-09	5	10	13	9	8	9
2023-10-10	15	11	11	11	7	11
2023-10-11	14	12	8	8	10	10.4
2023-10-12	13	11	10	11	16	12.2
2023-10-13	14	12	16	16	13	14.2
2023-10-14	17	26	28	24	19	22.8
2023-10-15	28	25	28	28	21	26
2023-10-16	27	24	29	24	25	25.8
2023-10-17	30	35	38	34	37	34.8
2023-10-18	26	30	34	38	42	34
2023-10-19	41	40	57	43	37	43.6
2023-10-20	8	3	4	10	9	6.8
2023-10-21	7	9	12	11	6	9

$\bar{x}$ = 17.135

s = 9.71

Step 2 製作 EWMA 表格

$L = 3$

$\lambda = 0.2$

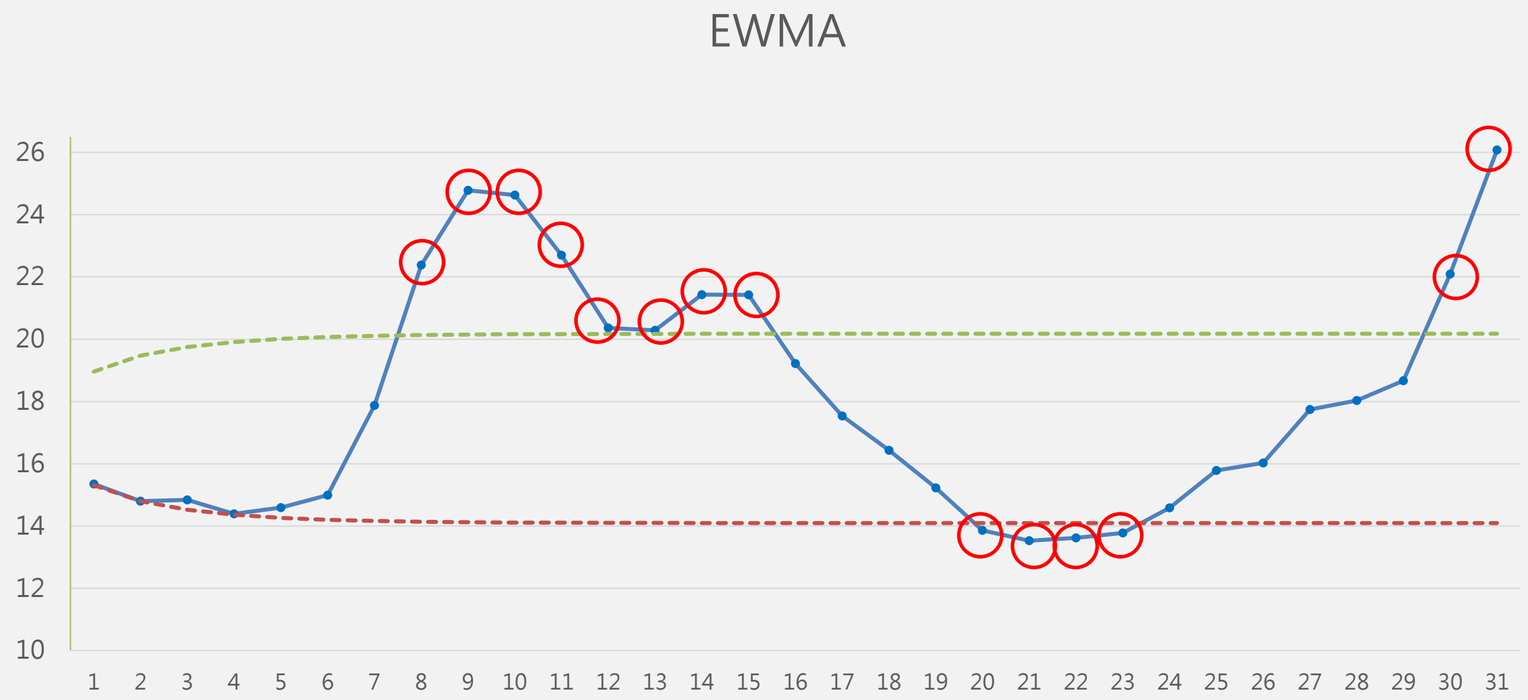
$z_i = \lambda \cdot x_i + (1-\lambda) \cdot z_{i-1} \quad where \;\; i = 0, 1, 2, \ldots, 31$

$$LCL = \mu - L \cdot \sigma \cdot \sqrt{(\frac{\lambda}{2-\lambda})[1-(1-\lambda)^{2i}]}$$

$$UCL = \mu + L \cdot \sigma \cdot \sqrt{(\frac{\lambda}{2-\lambda})[1-(1-\lambda)^{2i}]}$$

period	xi	z_i	LCL	UCL
1	8.2	15.3	15.310146	18.96
2	12.6	14.8	14.798047	19.472
3	15	14.8	14.522462	19.748
4	12.6	14.4	14.360416	19.91
5	15.4	14.6	14.261498	20.009
6	16.6	15	14.19994	20.07
7	29.4	17.9	14.161211	20.109
8	40.4	22.4	14.136687	20.133
9	34.4	24.8	14.121097	20.149
10	24	24.6	14.111161	20.159
11	15	22.7	14.104819	20.165
12	11	20.4	14.100767	20.169
13	20	20.3	14.098177	20.172
14	26	21.4	14.09652	20.173
15	21.4	21.4	14.095461	20.175
16	10.4	19.2	14.094782	20.175
17	10.8	17.5	14.094349	20.176
18	12	16.4	14.094071	20.176
19	10.4	15.2	14.093893	20.176
20	8.4	13.9	14.09378	20.176
21	12.2	13.5	14.093707	20.176
22	14	13.6	14.09366	20.176
23	14.4	13.8	14.09363	20.176
24	17.8	14.6	14.093611	20.176
25	20.6	15.8	14.093599	20.176
26	17	16	14.093591	20.176
27	24.6	17.7	14.093586	20.176
28	19.2	18	14.093583	20.176
29	21.2	18.7	14.093581	20.176
30	35.8	22.1	14.09358	20.176
31	42	26.1	14.093579	20.176

Step 3 繪製 EWMA



THANK YOU