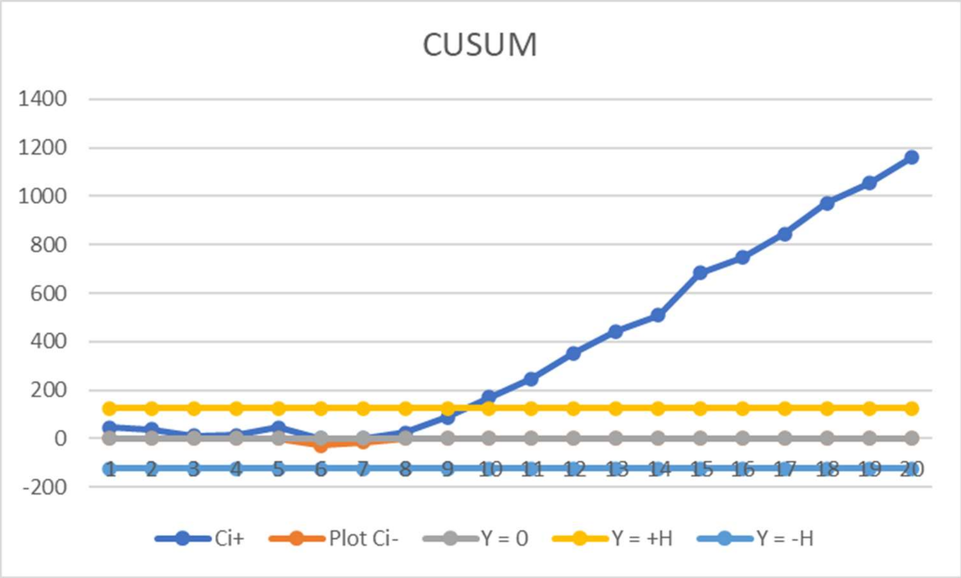
9.1. The data in Table 9E.1 represent individual observations on molecular weight taken hourly from a chemical process. The target value of molecular weight is 1,050 and the process standard deviation is thought to be about s = 25.

no	X\bar	Ci+	Ci-	Plot Ci-	Y = 0	Y = +H	Y = -H
1	1045	0	0	0	0	125	-125
2	1055	0	0	0	0	125	-125
3	1037	0	0.5	-0.5	0	125	-125
4	1064	1.5	0	0	0	125	-125
5	1095	34	0	0	0	125	-125
6	1008	0	29.5	-29.5	0	125	-125
7	1050	0	17	-17	0	125	-125
8	1087	24.5	0	0	0	125	-125
9	1125	87	0	0	0	125	-125
10	1146	170.5	0	0	0	125	-125
11	1139	247	0	0	0	125	-125
12	1169	353.5	0	0	0	125	-125
13	1151	442	0	0	0	125	-125
14	1128	507.5	0	0	0	125	-125
15	1238	683	0	0	0	125	-125
16	1125	745.5	0	0	0	125	-125
17	1163	846	0	0	0	125	-125
18	1188	971.5	0	0	0	125	-125
19	1146	1055	0	0	0	125	-125
20	1167	1159.5	0	0	0	125	-125

miu0 =	1050
delta =	1
sigma =	25
K =	12.5
H =	125

(a) Set up a tabular CUSUM for the mean of this process. Design the CUSUM to quickly detect a shift of about 1.0s in the process mean.

$\mu = 1050$ $\sigma = 25$ $\delta = 1s$ $K = \delta / 2 * \sigma = (1/2)*25=12.5$ $H = 5\sigma = 125$



(b) Is the estimate of s used in part (a) of this problem reasonable?

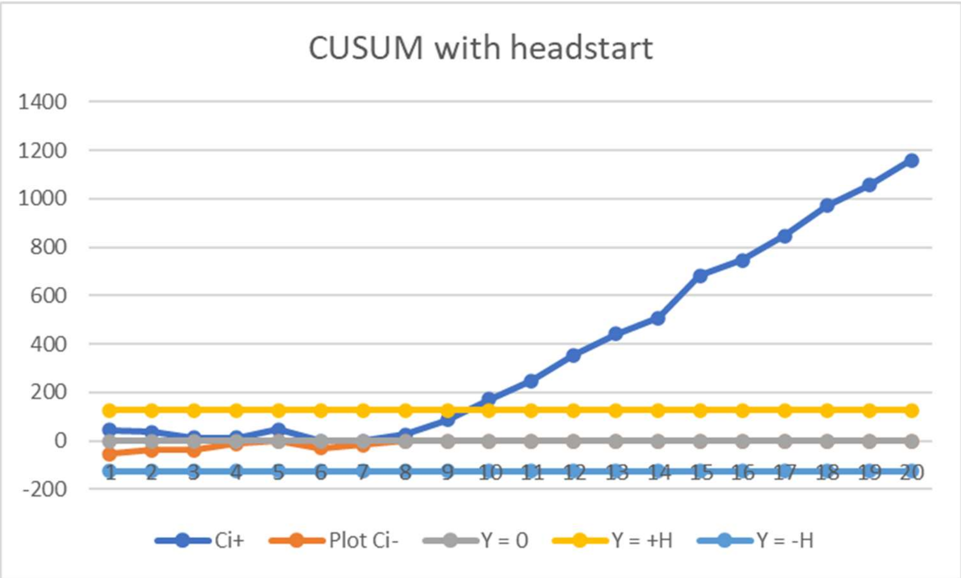
$\hat{\sigma}$ = MR / d2 = 38.8421/1.128 = 34.4345

No, the σ in this question is smaller than $\hat{\sigma}$

9.3.

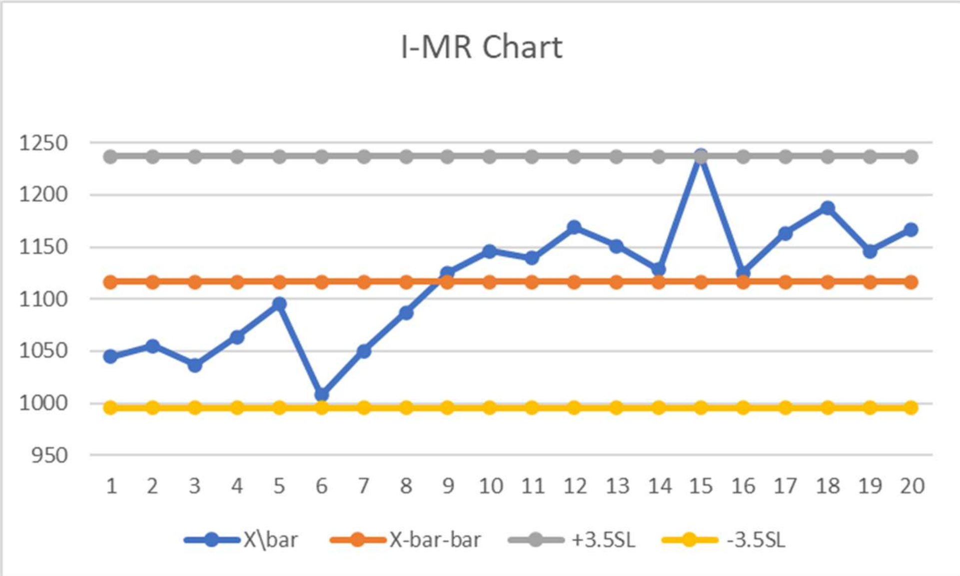
(a) Add a headstart feature to the CUSUM in Exercise 9.1.

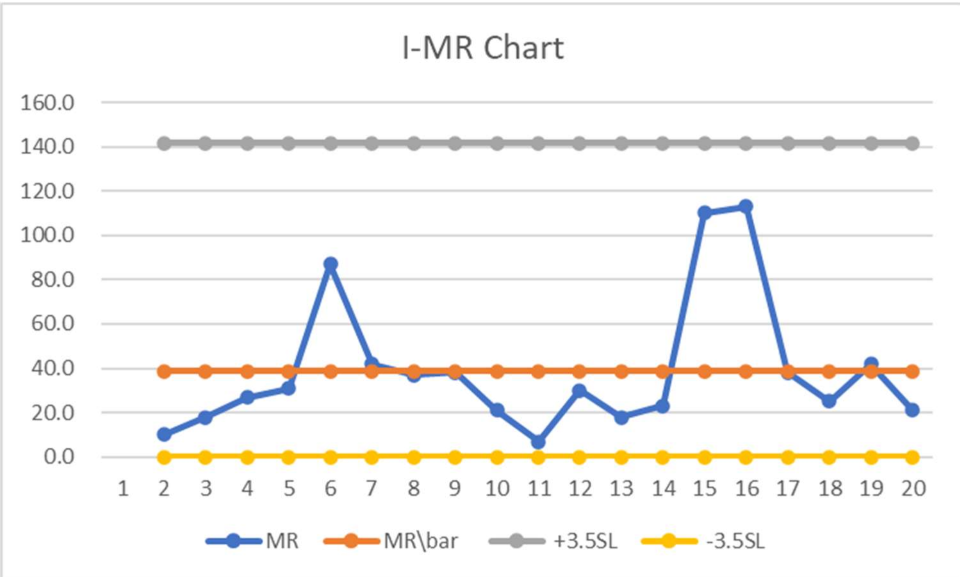
Headstart = H / 2 = 62.5



(b) Use a combined Shewhart–CUSUM scheme on the data in Exercise 9.1. Interpret the results of both charts.

平均	**+3.5SL**	**-3.5SL**	**MR\bar**
1116.3	1236.8	995.8	38.8421





9.5Bath concentrations are measured hourly in a chemical process. Data (in ppm) for the last 32 hours are shown in Table 9E.4 (read down from left). The process target is m0 = 175 ppm.

no	num	MR
1	160	
2	158	2
3	150	8
4	151	1
5	153	2
6	154	1
7	158	4
8	162	4

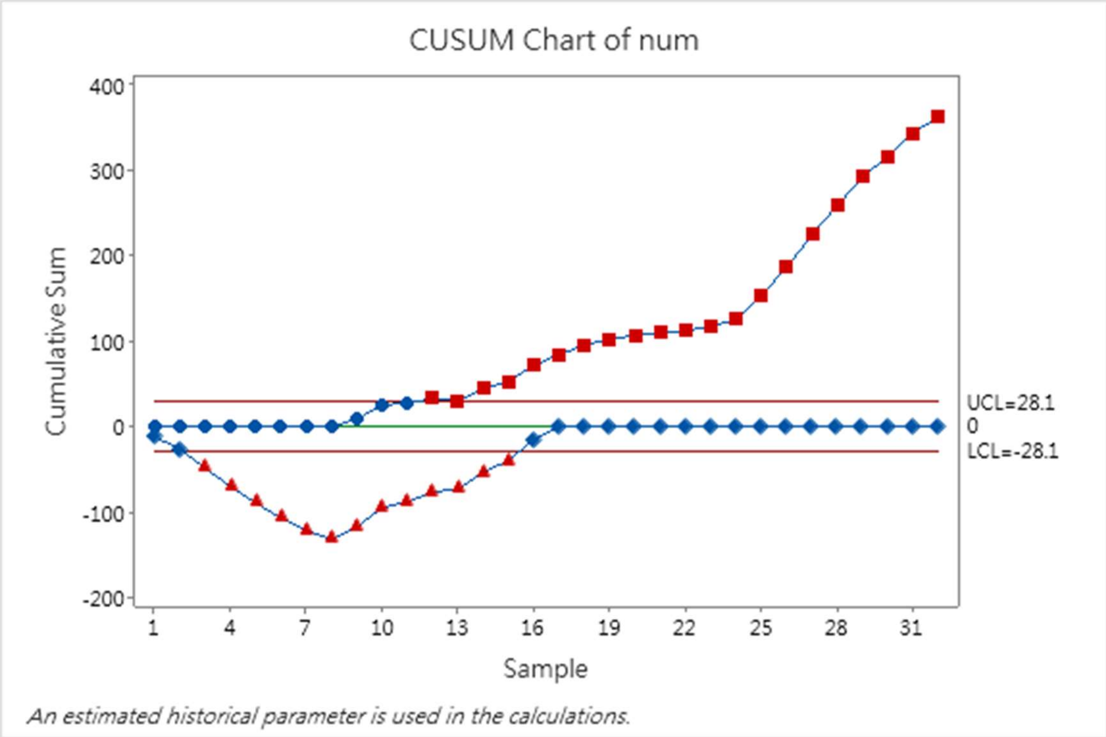
9	186	24		
10	195	9		
11	179	16		
12	184	5		
13	175	9		
14	192	17		
15	186	6		
16	197	11		
17	190	7	miu =	MR-bar =
18	189	1	183.59	6.35
19	185	4		
20	182	3		
21	181	1		
22	180	1		
23	183	3		
24	186	3		
25	206	20		
26	210	4		
27	216	6		
28	212	4		
29	211	1		
30	202	9		
31	205	3		
32	197	8		

(a) Estimate the process standard deviation.

$\hat{\sigma}$ = MR2 / d2 = 6.35 / 1.128 = 5.629

(b)Construct a tabular CUSUM for this process using standardized values of h = 5 and k = 1/2.

μ = 175 $\hat{\sigma}$ = 5.629 k = 1 /2 h = 5



Test Results for CUSUM Chart of num

TEST. One point beyond control limits.

Test Failed at points: 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32

9.6 Viscosity measurements on a polymer are made every 10 minutes by an on-line viscometer. Thirty-six observations are shown in Table 9E.5 (read down from left). The target viscosity for this process is m0 = 3,200.

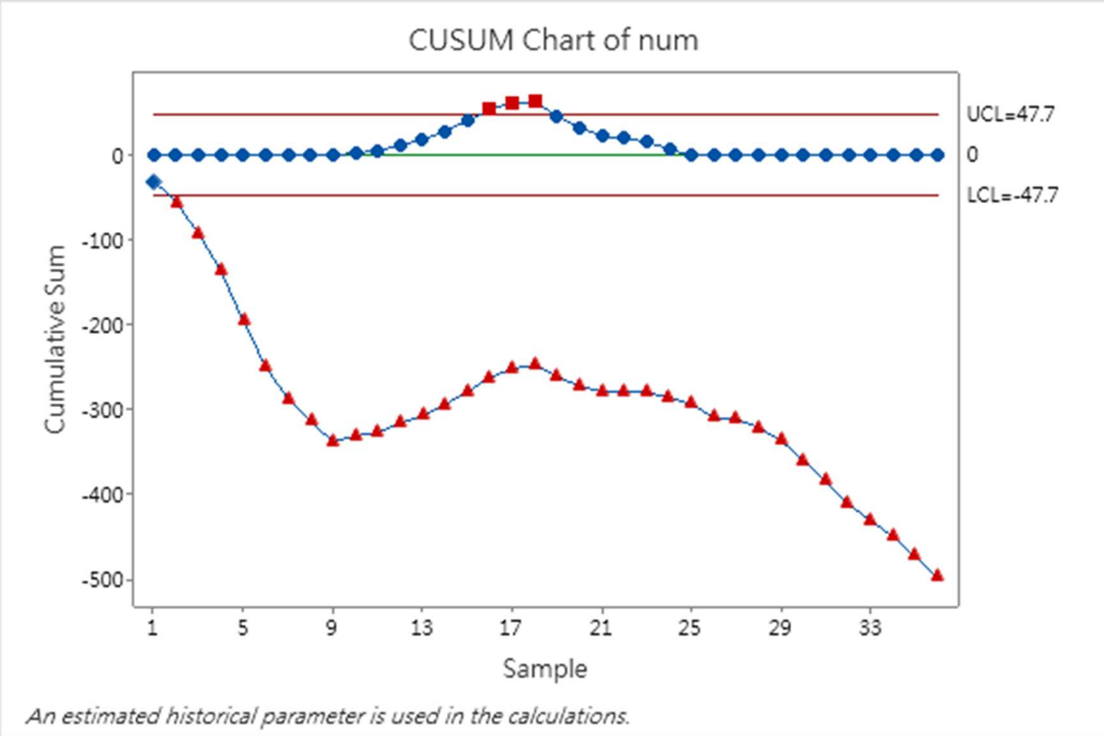
no	num	MR	
1	3169		
2	3173	4	
3	3162	11	
4	3154	8	
5	3139	15	
6	3145	6	
7	3160	15	
8	3172	12	
9	3175	3	
10	3205	30	
11	3203	2	
12	3209	6	
13	3208	1	MR-bar =

14	3211	3	6.7143
15	3214	3	
16	3215	1	
17	3209	6	
18	3203	6	
19	3185	18	
20	3187	2	
21	3192	5	
22	3199	7	
23	3197	2	
24	3193	4	
25	3190	3	
26	3183	7	
27	3197	14	
28	3188	9	
29	3183	5	
30	3175	8	
31	3174	1	
32	3171	3	
33	3180	9	
34	3179	1	
35	3175	4	
36	3174	1	

(a) Estimate the process standard deviation.

$\hat{\sigma}$ = MR2 / d2 = 6.71/1.128 = 5.949

(b)Construct a tabular CUSUM for this process using standardized values of h = 8.01 and k = 0.25.



Test Results for CUSUM Chart of num

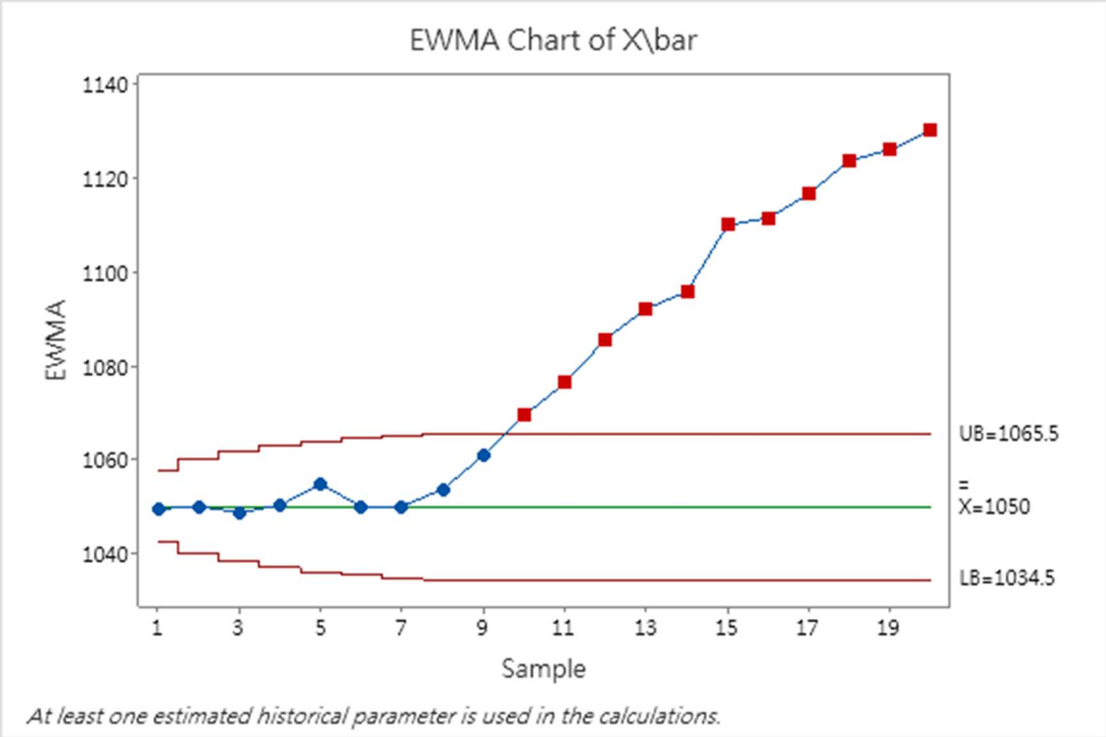
TEST. One point beyond control limits.

Test Failed at points: 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36

(c) Discuss the choice of h and k in part (b) of this problem on CUSUM performance.

k is smaller, so you need a bigger h to balance to give longer in-control ARLs.

9.15 Rework Exercise 9.1 using an EWMA control chart with l = 0.1 and L = 2.7. Compare your results to those obtained with the CUSUM.



The process was out of control after sample 10, is the same as cusum chart