

C_{pk} と P_{pk} の違い

工程能力指数

(Process **capability** index)

工程変動指数

(Process **performance** index)

$$C_{pk} = \text{Min}(C_{pu}, C_{pl})$$

$$P_{pk} = \text{Min}(P_{pu}, P_{pl})$$

$$C_{pu} = \frac{USL - \bar{\bar{x}}}{3\sigma}$$

$$P_{pu} = \frac{USL - \bar{\bar{x}}}{3s}$$

$$C_{pl} = \frac{\bar{\bar{x}} - LSL}{3\sigma}$$

$$P_{pl} = \frac{\bar{\bar{x}} - LSL}{3s}$$

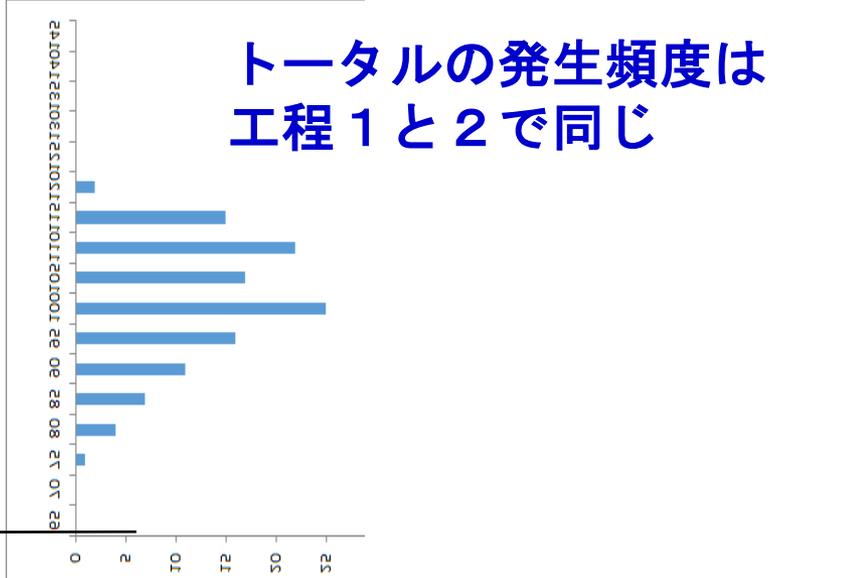
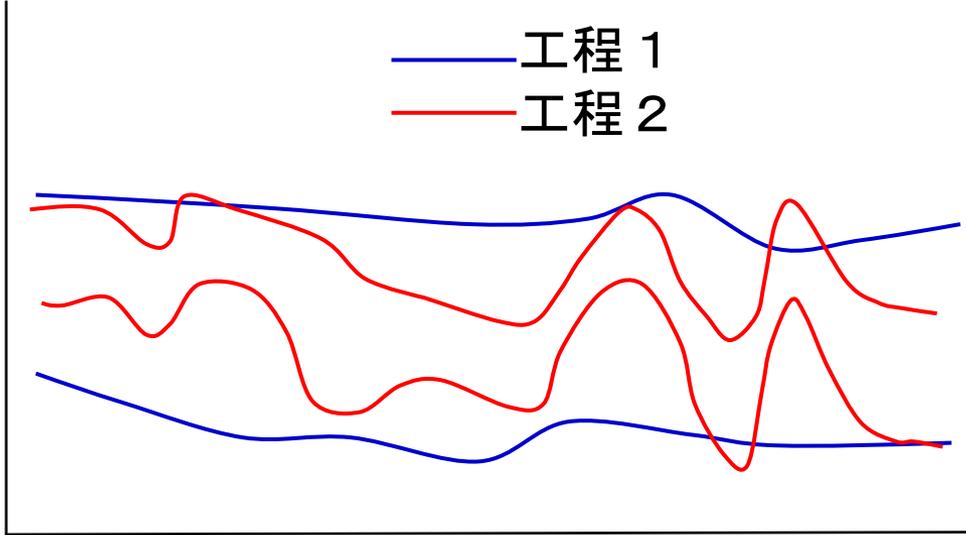
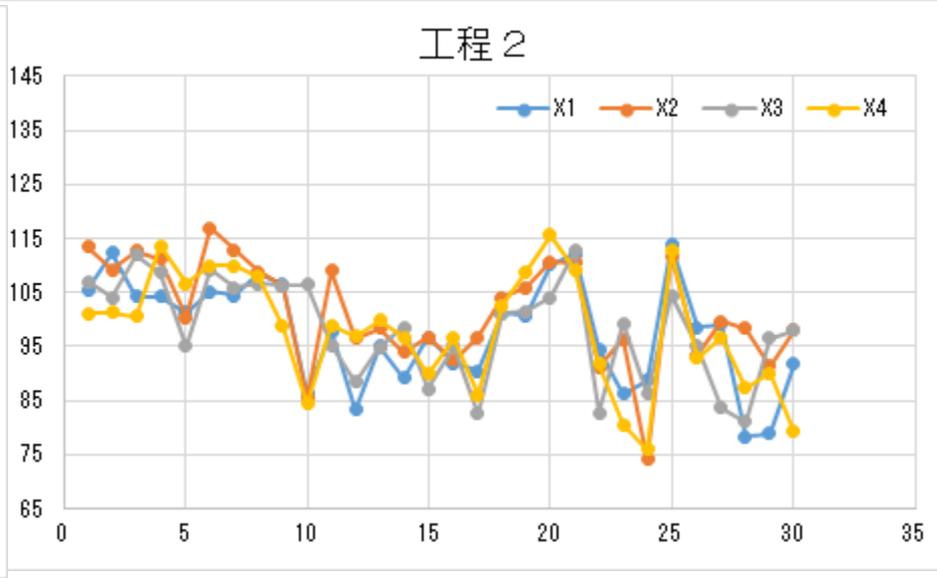
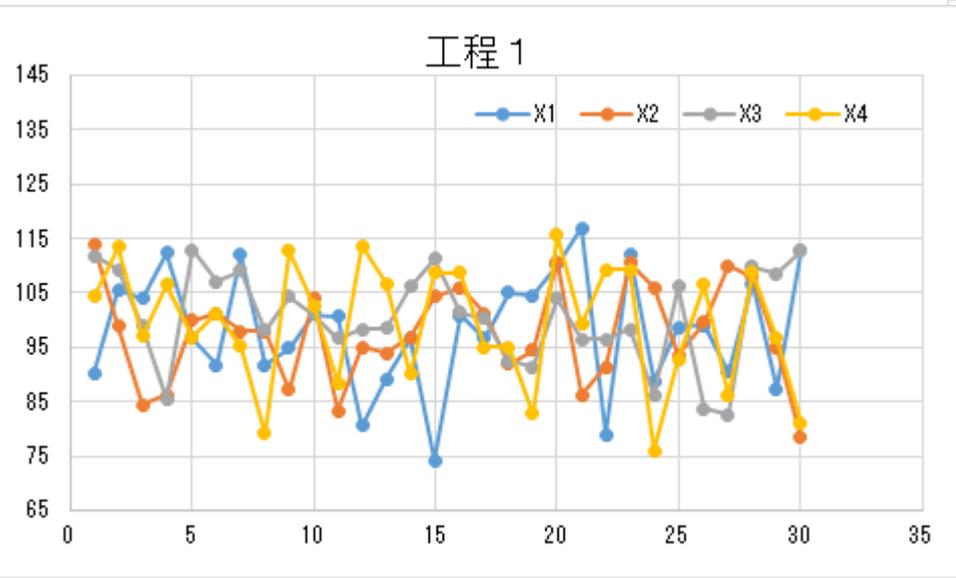
$$\sigma = \frac{\bar{R}}{d_2}$$

$$s = \sqrt{\frac{\sum(x_i - \bar{\bar{x}})^2}{N - 1}}$$

統計的管理状態にあることが実証された
プロセス

統計的管理状態にあることが実証されてい
るとは限らないプロセス

工程 1 と 2 は同じデータを並び替えてあります。



工程 1 : ばらつきは**大きい**が**変動小**
 工程 2 : ばらつきは**小さい**が**変動大**

工程 1

\bar{x} は x_1 から x_4 の平均

$R = X_{\max} - X_{\min}$

工程 2

Day	X1	X2	X3	X4	\bar{x}	R
1	90.2	113.8	111.8	104.4	105.1	23.6
2	105.6	98.8	109.3	113.5	106.8	14.7
3	104	84.5	98.9	97	96.1	19.5
4	112.4	86.2	85.5	106.5	97.7	26.9
5	96.6	99.9	112.9	96.8	101.6	16.3
6	91.7	101.3	107.1	101.2	100.3	15.4
7	112	97.9	109	95.2	103.5	16.8
8	91.8	98	98.1	79.2	91.8	18.9
9	94.9	87.1	104.3	112.7	99.8	25.6
10	101.1	104	101.1	102.7	102.2	2.9
11	100.6	83.3	96.6	88.5	92.3	17.3
12	80.5	95	98.3	113.6	96.9	33.1
13	89.2	93.9	98.5	106.7	97.1	17.5
14	96.7	96.8	106.2	90	97.4	16.2
15	74.2	104.3	111.2	108.7	99.6	37
16	100.8	106	101.5	108.8	104.3	8
17	96.7	101.3	100.4	95.1	98.4	6.2
18	105.1	92	92.5	95	96.2	13.1
19	104.5	94.5	91.3	82.7	93.3	21.8
20	110.1	110.7	104	115.6	110.1	11.6
21	116.9	86.3	96.4	99.3	99.7	30.6
22	78.9	91.4	96.5	109.2	94.0	30.3
23	112.2	110.5	98.3	109.2	107.6	13.9
24	88.8	105.9	86.3	76	89.3	29.9
25	98.6	93.5	106.2	92.8	97.8	13.4
26	99.1	99.6	83.6	106.5	97.2	22.9
27	90.5	110	82.6	86	92.3	27.4
28	106.7	107.9	109.9	108.8	108.3	3.2
29	87.4	95	108.5	96.7	96.9	21.1
30	112.7	78.4	112.8	81.1	96.3	34.4
平均	99.0				99.0	19.7
s	9.89				$\bar{\bar{x}}$	\bar{R}

全体の平均 $\bar{\bar{x}}$
 範囲の平均 \bar{R}

σ	9.54
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$\sigma = \frac{\bar{R}}{d_2}$

x	
UCL	113.3
LCL	84.7
R	
UCL	44.8
LCL	0

A2	0.729
d ₂	2.059
D3	2.282
D4	0

Day	X1	X2	X3	X4	\bar{x}	R
1	105.6	113.5	107.1	101.2	106.9	12.3
2	112.4	109.3	104	101.3	106.8	11.1
3	104.3	112.7	112	100.6	107.4	12.1
4	104.3	111.2	108.7	113.6	109.5	9.3
5	101.3	100.4	95.1	106.7	100.9	11.6
6	105.1	116.9	109.2	110	110.3	11.8
7	104.5	112.9	105.9	109.9	108.3	8.4
8	108.5	108.8	106.7	107.9	108.0	2.1
9	106.5	106.2	106.2	98.8	104.4	7.7
10	86.2	85.5	106.5	84.5	90.7	22
11	97.9	109	95.2	98.9	100.3	13.8
12	83.3	96.6	88.5	97	91.4	13.7
13	95	98.3	94.9	99.9	97.0	5
14	89.2	93.9	98.5	96.8	94.6	9.3
15	96.7	96.8	87.1	90	92.7	9.7
16	92	92.5	95	96.6	94.0	4.6
17	90.5	96.7	82.6	86	89.0	14.1
18	101.1	104	101.1	102.7	102.2	2.9
19	100.8	106	101.5	108.8	104.3	8
20	110.1	110.7	104	115.6	110.1	11.6
21	112.2	110.5	112.8	109.2	111.2	3.6
22	94.5	91.3	82.7	91.7	90.1	11.8
23	86.3	96.4	99.3	80.5	90.6	18.8
24	88.8	74.2	86.3	76	81.3	14.6
25	113.8	111.8	104.4	112.7	110.7	9.4
26	98.6	93.5	95	92.8	95.0	5.8
27	99.1	99.6	83.6	96.7	94.8	16
28	78.4	98.3	81.1	87.4	86.3	19.9
29	78.9	91.4	96.5	90.2	89.3	17.6
30	91.8	98	98.1	79.2	91.8	18.9
平均	99.0				99.0	11.3
s	9.89				$\bar{\bar{x}}$	\bar{R}

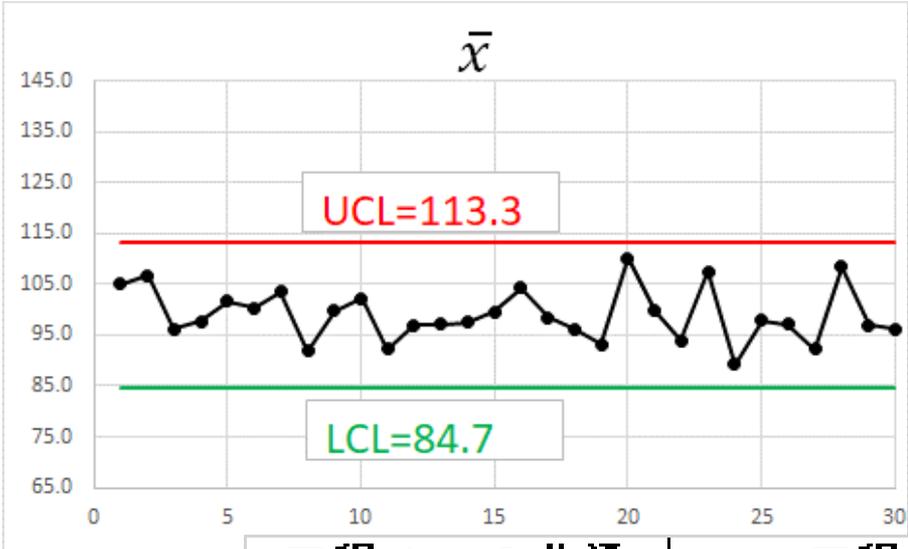
$s = \sqrt{\frac{\sum (x_i - \bar{x})^2}{N - 1}}$

x	
UCL	107.2
LCL	90.8
R	
UCL	25.7
LCL	0

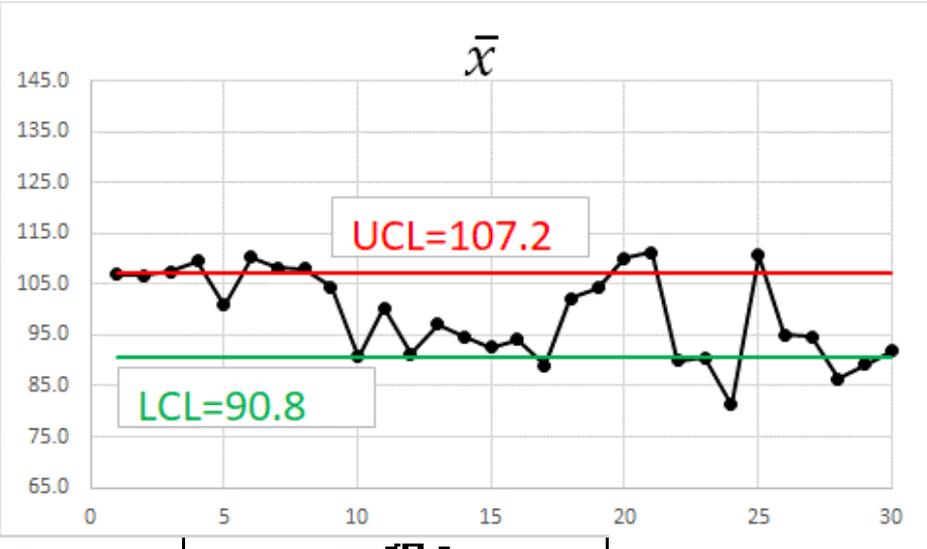
$$\begin{cases} UCL = \bar{\bar{x}} + A_2 \times \bar{R} \\ LCL = \bar{\bar{x}} - A_2 \times \bar{R} \end{cases}$$

$$\begin{cases} UCL = D_4 \times \bar{R} \\ LCL = D_3 \times \bar{R} \end{cases}$$

工程 1



工程 2



工程 1、2 共通		工程 1		工程 2	
s	9.89	σ	9.54	σ	5.46
Ppu	1.55	Cpu	1.61	Cpu	2.81
Ppl	1.14	Cpl	1.19	Cpl	2.07

P_{pk} →

← C_{pk}

