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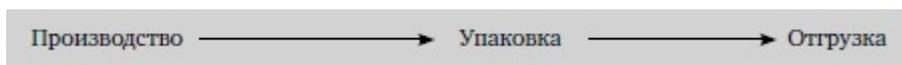
« »

1.

« » « » (. 1). ,
(. 2).



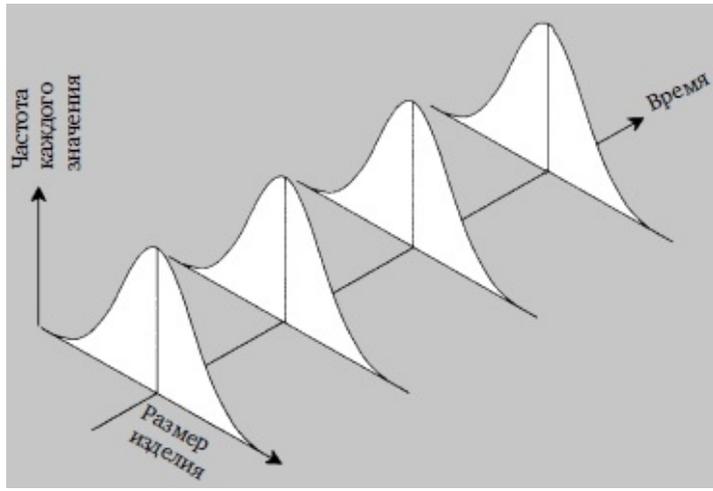
. 1.



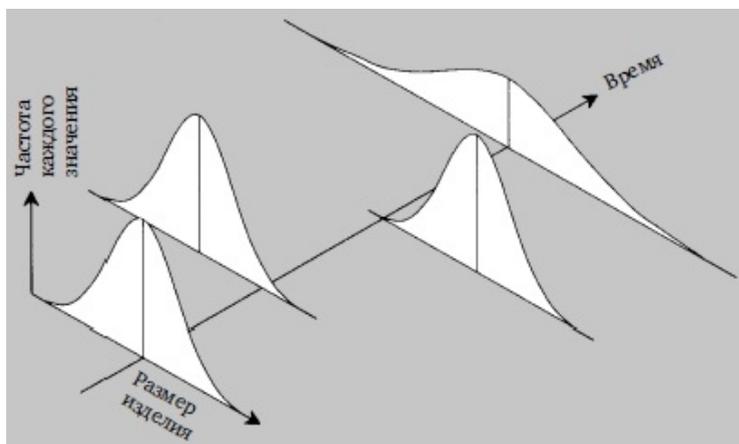
. 2.

« » (. 3).

(. 4).



. 3.



. 4.

-
-
-
-

100%

100%

(SPC, Statistical Process Control)

2.

50-

X.

X□.

R.

« » ,

15.

s_n ,

n

$$(1) s_n = \sqrt{\frac{\sum_{i=1}^n (X_i - \bar{X})^2}{n}}$$

$$(2) s = \sqrt{\frac{\sum_{i=1}^n (X_i - \bar{X})^2}{n-1}}$$

», s_n —

(Excel

s

«

$(n - 1)$;

$- n.$

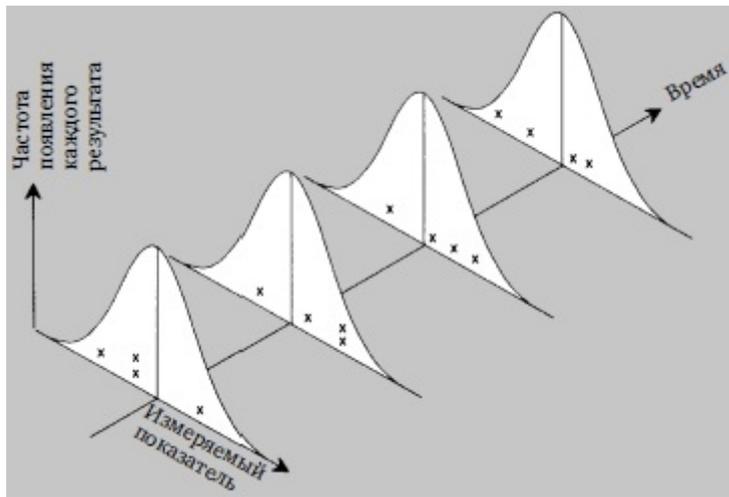
_____)

«

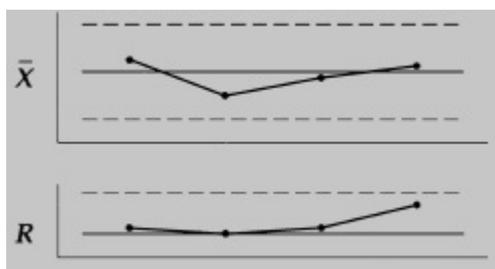
»

(_____).

(.5).



. 6.



. 7.

Excel-) —

(. 8; .
0,300 .

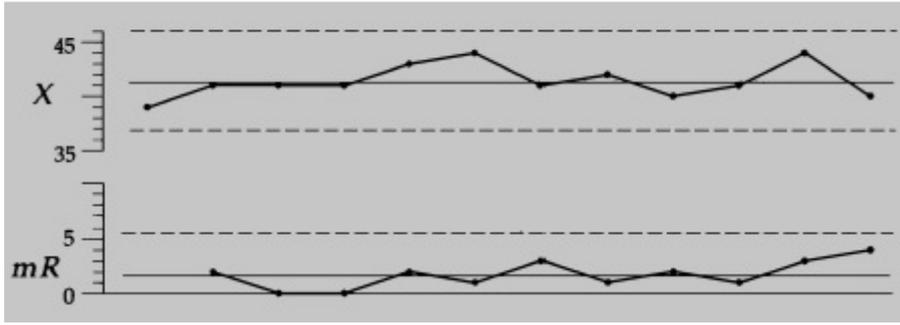
	A	B	C	D	E	F	G
1	Номер подгруппы	Значения			Среднее	Размах	
2	1	1	4	6	4	3,75	5
3	2	3	7	5	5	5,00	4
4	3	4	5	5	7	5,25	3
5	4	6	2	4	5	4,25	4
6	5	1	6	7	3	4,25	6
7	6	8	3	6	4	5,25	5
8	7	7	5	6	6	6,00	2
9	8	5	3	4	6	4,50	3
10	9	4	5	9	2	5,00	7
11	10	7	5	6	5	5,75	2
12	11	4	5	6	5	5,00	2
13	12	6	7	8	5	6,50	3
14	13	3	3	7	3	4,00	4
15	14	6	3	2	9	5,00	7
16	15	7	3	4	3	4,25	4
17	16	6	4	6	5	5,25	2
18	17	5	5	0	5	3,75	5
19	18	6	4	6	3	4,75	3
20	19	6	4	4	0	3,50	6
21	20	6	2	5	4	4,25	4
22							

. 8.

: 20

4

X	39	41	41	41	43	44	41	42	40	41	44	40
mR		2	0	0	2	1	3	1	2	1	3	4



. 11. , mR- (mR -)

4.

s:

- a)
- b)

100%

, 99,7%

[Excel.](#)

1

99 100%

(n = 1).

1.

3 -

2.

3.

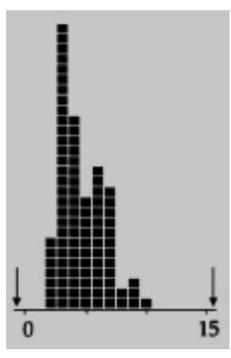
4.

, SPC

¹ [Робастность](#) (англ. robustness, от robust — «крепкий», «сильный», «твёрдый», «устойчивый») — свойство статистического метода, характеризующее независимость влияния на результат исследования различного рода выбросов, устойчивости к помехам.

1. , () () ,
) ,
 , 2/3 95% — $X \pm 2$. $X \pm$,
 2. .
 3. , .
 4. , .
 5. , .
 6. , .
6. ,

(. 12).



. 12.

(,)

(NPL)

NPL

$$= X \pm 3 (X) = X \pm 3R/d_2$$

NPL — « », NPL . , 100% , : . « » « » .

NPL: C_p —

$= (\dots) / 6 ()$

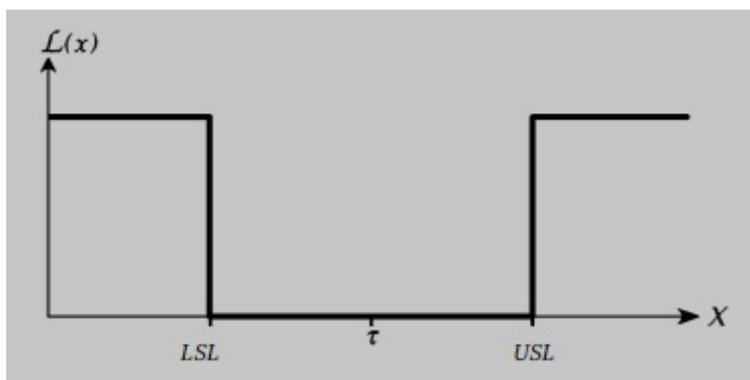
6,0. C_p — , C_{pk} ()

), 3,0: (-)

$C_{pk} = DNS/3$

DNS (, the distance to the nearest specification) — (-). C_{pk} C_p .

13).

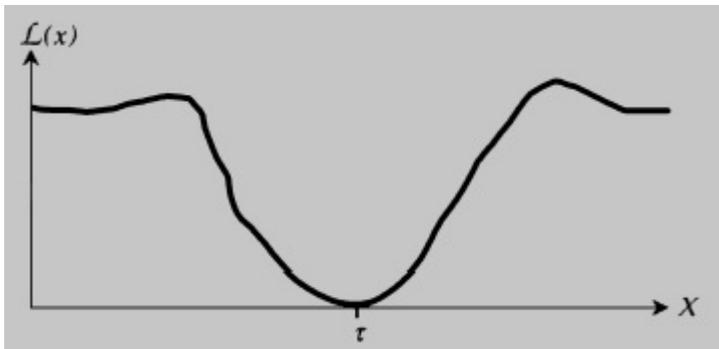


. 13. $L(x)$; — , LSL USL —

1960 .

(. 14).

$$L(x) = K(x - \tau)^2,$$



. 14.

$L(x)$,

X .

$L(x) f(x)$.

$L(x)$:

$$(3) E[L(x)] = \int_{\bar{x}} L(x) f(x) dx$$

$$K(x - \tau)^2,$$

$L(x)$

$$E = K[\sigma^2 + (\mu - \tau)^2],$$

(, $\mu - \tau$)

$X, (\mu - \tau)^2$
 $f(X)$.

X .

(. .)

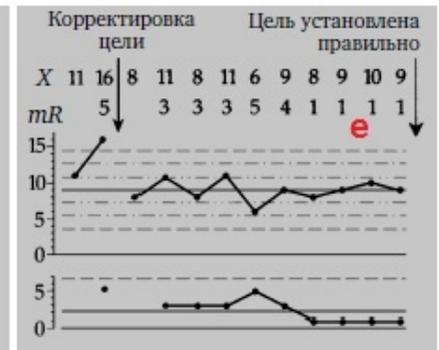
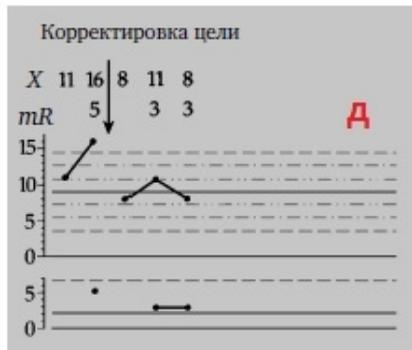
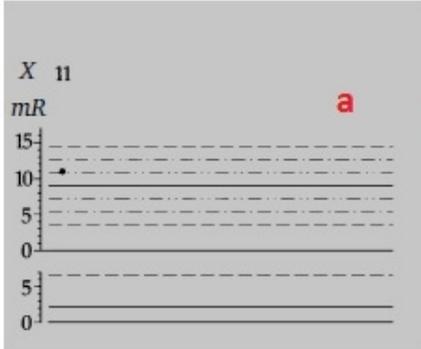
7.

8.

« » —
« » —
« » —

1 -

(. 15).



. 15.

11 ().

16 ().

$(11+16)/2 = 13,5.$

8

4 ().

11 ().

8 ().

11, 6, 9, 8, 9, 10 9 ().

9.

()

1, 2 3

$XmR-$

?

$XmR-$

2)

: 1)

$XmR-$

$XmR-$

$n = 1.$

[Excel.](#)

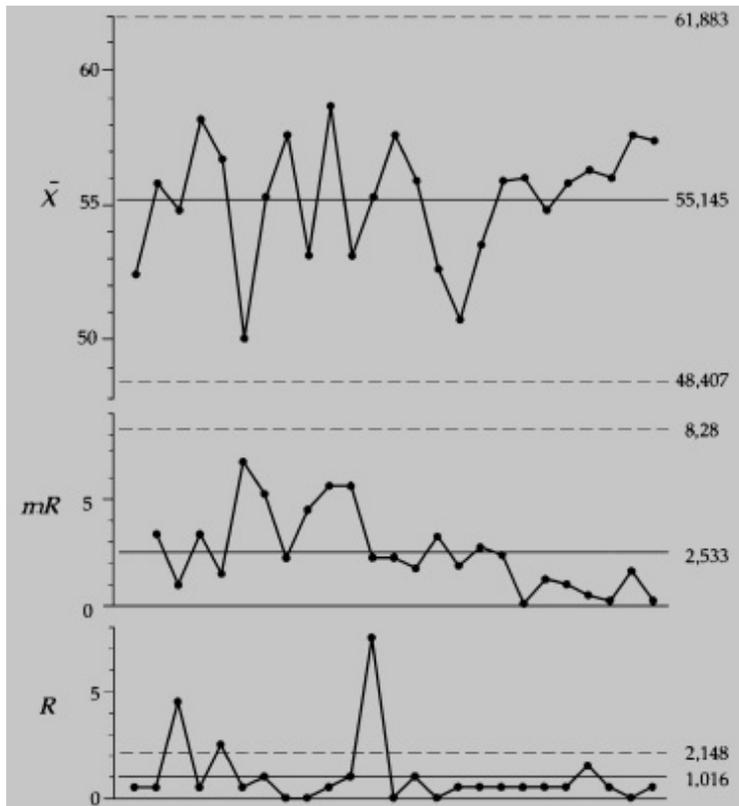
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)

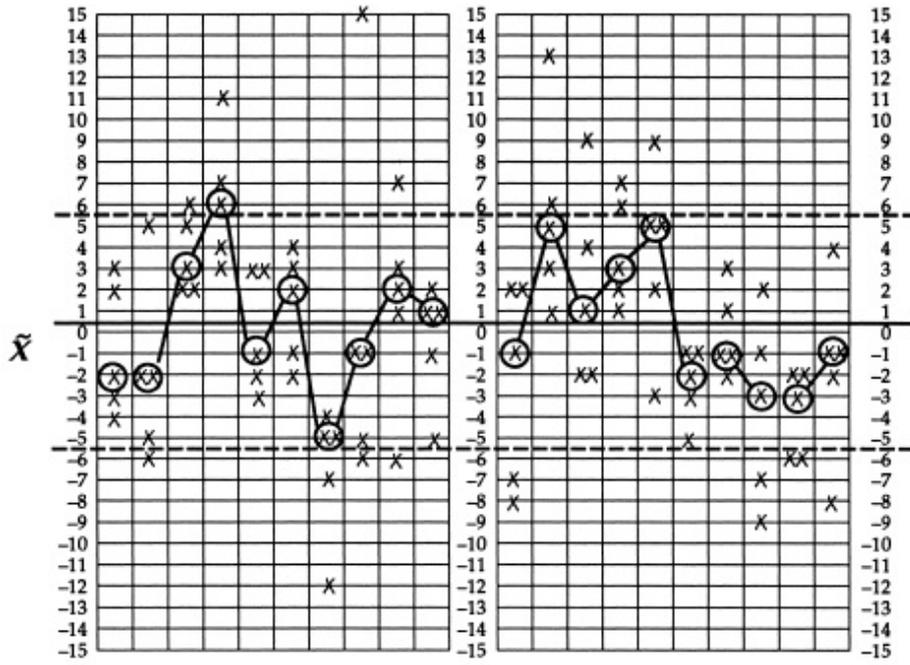
(. 16).



. 16.

()

(. 17).



. 17.

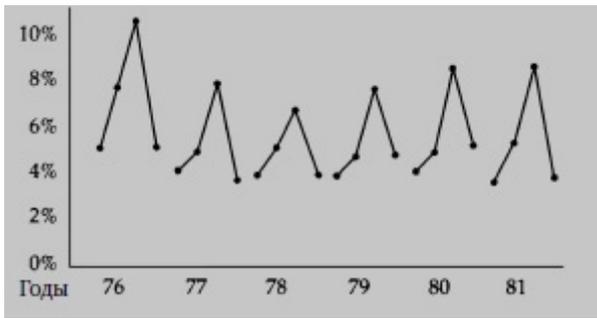
10.

XmR- ()
 (p-, np-, c-, u-).

11.

4%

18).



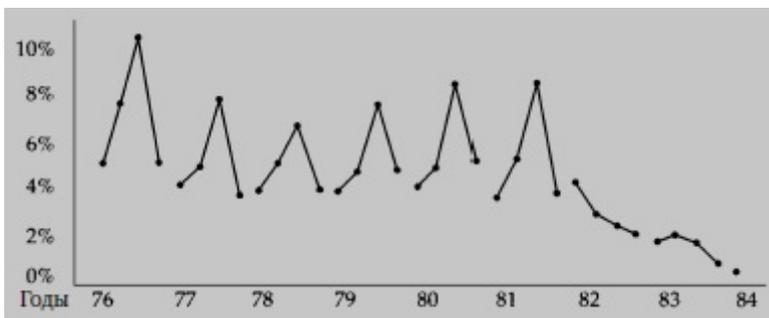
. 18.

1976-1981 .

1982 .

3%
2,5%.

(. 19).



. 19.

1976-1984 .

14

«

».

12.

«...»

1950 .

«...»

«...»,

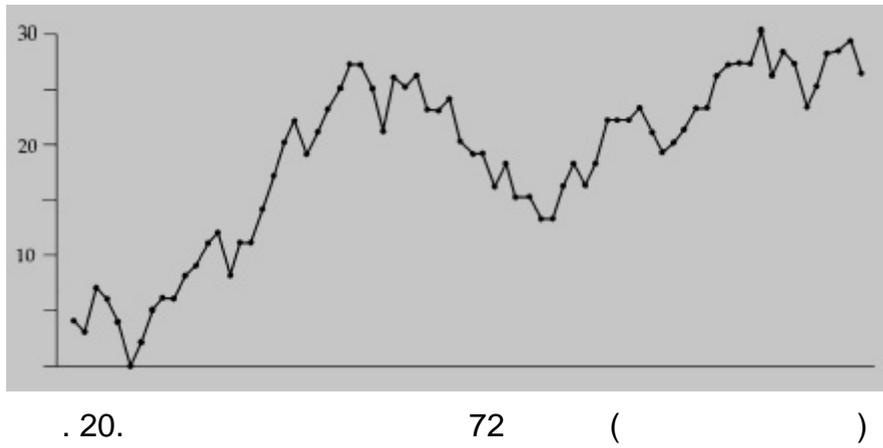
«...»: 20% 80%

(.....).

13.

3).

(
Excel
(.20).



Excel (

. — ∴ , 1988.
∴
. — ∴ , 2007.
∴ . — ∴ , 1981