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$i,$ $i.$

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$n_1, x_2 - n_2, \dots, x_k - n_k$ $\sum n_i = n -$ x_1

x_i

$n_i/n = w_i -$

x $F^*(x),$

$X < x,$ $X -$

$F^*(x) = n_x/n,$ $n_x -$

$x; n -$ $F(x)$

$(x_1; n_1), (x_2; n_2), \dots, (x_k; n_k).$ $(x_1; w_1), (x_2; w_2), \dots, (x_k; w_k).$

$n_i -$ h $i-$

$n_i/h ($ $h,$

, $n \rightarrow \infty$

2.1

\bar{x}

.

x_1, x_2, \dots, x_N

$$\bar{x} = (x_1 + x_2 + \dots + x_N)/N.$$

x_1, x_2, \dots, x_k

$N_1, N_2, \dots,$

$N_k,$

$$N_1 + N_2 + \dots + N_k = N,$$

$$\bar{x} = (x_1 N_1 + x_2 N_2 + \dots + x_k N_k)/N.$$

.

, n ,

$$\bar{x} = (x_1 + x_2 + \dots + x_n)/n.$$

x_1, x_2, \dots, x_k

$n_1, n_2, \dots, n_k,$

$$n_1 + n_2 + \dots + n_k = n,$$

$$\bar{x} = (x_1 n_1 + x_2 n_2 + \dots + x_k n_k)/n = \left(\sum_{i=1}^k x_i n_i \right) / n.$$

\bar{x} -

,

\bar{x} ,

-

D -

\bar{x} .

$x_1, x_2, \dots, x_n,$

, n ,

$$D = \left(\sum_{i=1}^n (x_i - \bar{x})^2 \right) / n.$$

x_1, x_2, \dots, x_k

$n_1, n_2, \dots, n_k,$

$$n_1 + n_2 + \dots + n_k = n,$$

$$D = \left(\sum_{i=1}^k n_i (x_i - \bar{x})^2 \right) / n.$$

$$\sigma = \sqrt{D_B}.$$

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,

$$D = \overline{x^2} - [\bar{x}]^2,$$

$$\overline{x^2} = (\sum n_i x_i^2) / n, \quad \bar{x} = (\sum n_i x_i) / n.$$

$$M[D] = \frac{n-1}{n} D.$$

$$S^2 = \frac{n}{n-1} D_B = \frac{\sum_{i=1}^k n_i (x_i - \bar{x}_B)^2}{n-1}.$$

$$n < 30.$$

3

() 100 .

	154 - 158	158 - 162	162 - 166	166 - 170	170 - 174	174 - 178	178 - 182
i -	10 + N	14	26 - N	28 - N	12	8	2 + N

2.2

().

$$|\theta - \theta^*| < \delta.$$

θ^*

γ ,

θ .

δ

θ^*

$$P(|\theta - \theta^*| < \delta) = \gamma,$$

$$P(|\theta - \theta^*| < \delta) = \gamma \quad \text{for } \theta \in (\theta^* - \delta, \theta^* + \delta),$$

0,95; 0,99; 0,999.

2.3

X

σ

a

a

\bar{x}

$$P(\bar{x} - t\sigma/\sqrt{n} < a < \bar{x} + t\sigma/\sqrt{n}) = 2\Phi(t) - 1 = \gamma.$$

t

$$2\Phi(t) - 1 = \gamma, \quad \Phi(t) = \gamma/2 + 0,5;$$

t ,

$$\Phi^{-1}(\gamma/2 + 0,5).$$

1

X

$$\sigma = 3.$$

a

$$\bar{x} = 4,1,$$

$$n = 36$$

$$\gamma = 0,95.$$

t .

$$2\Phi(t) - 1 = 0,95$$

$$\Phi(t) = 0,475.$$

$$t = 1,96.$$

$$\delta = t\sigma/\sqrt{n} = (1,96 \cdot 3)/\sqrt{36} = 0,98.$$

$$: (\bar{x} - 0,98; \bar{x} + 0,98) \quad (3,12; 5,08).$$

4

X

$$\sigma = 3 + \frac{N+1}{50}.$$

a

$$\bar{x} = 5,1 + N,$$

$$n = 36 \cdot (N+1)^2$$

$$\gamma = 0,95.$$

3

Y

X

(,).

3.1

$$r_B = \frac{\sum n_{xy}xy - n\bar{x} \cdot \bar{y}}{n\bar{\sigma}_x \cdot \bar{\sigma}_y},$$

x, y – () X, Y, n_{xy} –
 $(x, y), n$ – , (); $\bar{\sigma}_x, \bar{\sigma}_y$ –

$r = \pm 1$, X, Y , $r = 0$;
 $r = 0$, X, Y .

3.2

X, Y

$$\bar{y}_x - \bar{y} = r_B \frac{\bar{\sigma}_y}{\bar{\sigma}_x} (x - \bar{x}),$$

Y, X , X

Y

$$\bar{x}_y - \bar{x} = r_B \frac{\bar{\sigma}_x}{\bar{\sigma}_y} (y - \bar{y}).$$

X, Y .

2

Y, X

3.1.

3.1

Y	X						n _y
	10	20	30	40	50	60	
15	5	7	–	–	–	–	12
25	–	20	23	–	–	–	43
35	–	–	30	47	2	–	79
45	–	–	10	11	20	6	47
55	–	–	–	9	7	3	19
n _x	5	27	63	67	29	9	n=200

$$u_i = (x_i - c_1) / h_1 = (x_i - 40) / 10 \quad ($$

$$x=40,$$

$$; \quad h_1$$

$$20-10=10) \quad v_j = (y_j - c_2) / h_2 = (y_j - 35) / 10.$$

$$: \quad 2 \quad (\quad 35) \quad 0;$$

$$-1, -2; \quad 1, 2.$$

$$1 \quad (\quad 40) \quad 0; \quad -1, -2, -3;$$

$$1, 2.$$

$$2$$

3.2

V	u						n _v
	-3	-2	-1	0	1	2	
-2	5	7	–	–	–	–	12
-1	–	20	23	–	–	–	43
0	–	–	30	47	2	–	79
1	–	–	10	11	20	6	47
2	–	–	–	9	7	3	19
n _u	5	27	63	67	29	9	n=200

$$r_B = \frac{\sum n_{uv} uv - n\bar{u} \cdot \bar{v}}{n\bar{\sigma}_u \cdot \bar{\sigma}_v}.$$

$$\sum n_{uv} uv$$

3.3.

:

3.3

v	u						$U = \sum n_{uv}u$	vU
	-3	-2	-1	0	1	2		
-2	5 ⁻¹⁵ -10	7 ⁻¹⁴ 14	—	—	—	—	-29	58
-1	—	20 ⁻⁴⁰ -20	23 ⁻²³ -23	—	—	—	-63	63
0	—	—	30 ⁻³⁰ 0	47 ⁰ 0	2 ² 0	—	-28	0
1	—	—	20 ⁻¹⁰ 10	20 ⁰ 11	20 ²⁰ 20	6 ¹² 6	22	22
2	—	—	—	9 ⁰ 18	7 ⁷ 14	3 ⁶ 6	13	26
$V = \sum n_{uv}v$	-10	-34	-13	29	34	12		$\sum vU = 169$
uV	30	68	13	0	34	24	$\sum uV = 169$	\leftarrow

1. $n_{uv} \neq 0$,
 $n_{uv} \cdot u$.
 : $5(-3) = -15$; $7(-2) = -14$.

2. U .
 $U = -15 + (-14) = -29$.

3. $v \cdot U$.
 vU .
 $v = -2, U = -29$;
 $vU = (-2) \times (-29) = 58$.

4. $\sum vU$,
 $\sum n_{uv}uv$.
 $\sum vU = 169$.

$\sum_u uV$, $\sum n_{uv}uv$.
 \bar{u} \bar{v} :
 $\bar{u} = (\sum n_u u) / n = [5 \cdot (-3) + 27 \cdot (-2) + 63 \cdot (-1) + 29 \cdot 1 + 9 \cdot 2] / 200 = -0,425$
 $\bar{v} = (\sum n_v v) / n = [12 \cdot (-2) + 43 \cdot (-1) + 47 \cdot 1 + 19 \cdot 2] / 200 = 0,19$
 \bar{u}^2 , σ_u :

$$\overline{u^2} = (\sum n_u \cdot u^2) / n = (5 \cdot 9 + 27 \cdot 4 + 63 \cdot 1 + 29 + 1 + 9 \cdot 4) / 200 = 1,405$$

$$\overline{\sigma}_u = \sqrt{\overline{u^2} - (\overline{u})^2} = \sqrt{1,405 - (0,425)^2} = 1,106.$$

$$\overline{\sigma}_v = 1,209.$$

$$r_B = \frac{\sum n_{uv} u \cdot v - n \cdot \overline{u} \cdot \overline{v}}{n \cdot \overline{\sigma}_u \cdot \overline{\sigma}_v} = \frac{169 - 200 \cdot (-0,425) \cdot 0,09}{200 \cdot 1,106 \cdot 1,209} = 0,603.$$

$$\overline{x} = \overline{u}h_1 + c_1 = -0,425 \cdot 10 + 40 = 35,75$$

$$\overline{y} = \overline{v}h_2 + c_2 = 0,09 \cdot 10 + 35 = 35,9$$

$$\overline{\sigma}_x = \overline{\sigma}_u h_1 = 1,106 \cdot 10 = 11,06$$

$$\overline{\sigma}_y = \overline{\sigma}_v h_2 = 1,209 \cdot 10 = 12,09$$

$$\overline{y}_x - 35,9 = 0,603 \cdot \frac{12,09}{11,06} (x - 35,75)$$

$$\overline{y}_x = 0,659x + 12,34.$$

) ;

) 1.

, $\overline{y}_x = 0,659 \cdot 30 + 12,34 = 32,11$;

) $\overline{y}_x = \frac{(23 \cdot 25 + 30 \cdot 35 + 10 \cdot 45)}{63} = 32,94.$

5

(X, Y).

-) ;
- 1) Y X;
- 2) $x = 30$, ;
-) ;
-) ;
- 3) X Y;
- 4) $y = 35 + N$, ;
-) ;
-) ;
- 5) .

1. , 1977.
2. , 1975.
3. :
4. - ∴ , 1991.
. - ∴ , 1982.