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Tanlanmaning ikkinchi darajali regressiya tenglamasini tenlamasini kichik kvadratlar usulida aniqlash

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A R T I C L E I N F O.

Kalit so'zlar: *regressiya, kriteriya, model, adekvat, Maple, seq, add.*

Annotatsiya:

Hozirgi vaqtda har qanday jiddiy statistik hisob-kitoblar, qoida tariqasida, kompyuterlarda va birinchi navbatda, shaxsiy kompyuterlarda amalga oshiriladi. Ushbu maqolada Maple dasturidan foydalanib muxandislik va iqtisodiyot masalalarning tajriba natijalari bo'yicha tuzilgan matematik modellarning sifat va samatadorligi hamda raqamli usullardan foydalanib tahlil va qaror qabul qilishda axamiyatli ekanligi ko'rsatilgan.

Statistik ma'lumotlarni qayta ishlashda regression taxlil bo'yicha tajriba natijalarining chiziqsiz-ikkinchi darajali regressiya tenglamasini matematik modeli eng kichik kvadratlar usulidan foydalanib tuzish va bu modelni sifatini ko'rsatamiz[5,8,9].

ASOSIY QISM. 1. Tanlanmada Y ning *X* ga bog'lanishining ikkinchi darajali regressiya tenglamasini aniqlash.

Ikkinch darajali regressiya tenglamasini topishni quyidagi misol orqali izohlaymiz. Soddaroq bo'lishi uchun kichikroq jadval, hamda chiziqli bo'lmagan eng ommalashgan holi kvadrat uchhad ko'rinishi bilan chegaralanamiz.

Quyidagi korrelyasion jadvalda keltirilgan ma'lumotlar bo'yicha $y = ax^2 + bx + c$ regressiya tenglamasini eng kichik kvadratlar usuli yordamida topamiz.

1-jadval

y \ x	2	3	5	n_y
25	20			20
45		30	1	31
110		1	48	49

n_x	20	31	49	N=100

Buning uchun *a, b,c* parametrlarni

$$F(a,b,c)=\sum\left(y_{x_i}-\overline{y}_{x_i}\right)^2 n_{x_i}=\sum\left(ax_i^2+bx_i+c-\overline{y}_{x_i}\right)^2 n_{x_i}$$

farqlarning kvadratlari minimal bo‘ladigan qilib tanlab olish imkonini beruvchi quyidagi tenglamalar sistemasini hosil qilamiz:

$$\frac{\partial F(a,b,c)}{\partial a}=2\sum\left(ax_i^2+bx_i+c-\overline{y}_{x_i}\right)x_i^2 n_{x_i}=0$$
$$\frac{\partial F(a,b,c)}{\partial b}=2\sum\left(ax_i^2+bx_i+c-\overline{y}_{x_i}\right)x_i n_{x_i}=0$$
$$\frac{\partial F(a,b,c)}{\partial c}=2\sum\left(ax_i^2+bx_i+c-\overline{y}_{x_i}\right)n_{x_i}=0$$

bu sistemadan:

$$\begin{cases}\left(\sum n_x x^4\right)a+\left(\sum n_x x^3\right)b+\left(\sum n_x x^2\right)c=\sum n_x\overline{y}_x x^2\\ \left(\sum n_x x^3\right)a+\left(\sum n_x x^2\right)b+\left(\sum n_x x\right)c=\sum n_x\overline{y}_x x\\ \left(\sum n_x x^2\right)a+\left(\sum n_x x\right)b+nc=\sum n_x\overline{y}_x\end{cases} \qquad (*)$$

Bu sistemadagi yig‘indilarni quyidagicha topamiz:

1-jadval asosida shartli o‘rta qiymatlarni topamiz.

$$\overline{y}_2=\frac{25\cdot 20}{20}=25$$
$$\overline{y}_3=\frac{45\cdot 30+110\cdot 1}{31}=47{,}1$$
$$\overline{y}_5=\frac{45\cdot 1+110\cdot 48}{49}=108{,}67$$

2-jadval

x	n_x	$\overline{y}_x$	$n_x x$	$n_x x^2$	$n_x x^3$	$n_x x^4$	$n_x\overline{y}_x$	$n_x\overline{y}_x x$	$n_x\overline{y}_x x^2$
2	20	25	40	80	160	320	500	1000	2000

3	31	47,1	93	279	837	2511	4380	13140	13141
5	49	108,67	245	12285	6125	30625	5325	26625	133121
∑	100		378	1584	7122	33456	7285	32004	148262

2-jadval oxirida turgan yig‘indilarni (*) sistemaga qo‘yib, quyidagi sistemani hosil qilamiz:

$$\begin{cases} 33456\,a + 7122\,b + 1584\,c = 148262 \\ 7122\,a + 1584\,b + 378\,c = 32004 \\ 1584\,a + 378\,b + 100\,c = 7285 \end{cases}$$

Sistemani echib, a=2.94, b=7.27, c =-1,25 qiymatlarni topamiz va bu qiymatlarni regressiya tenglamasi:

$$\bar{y}_x = ax^2 + bx + c$$

ga qo‘yib,

$$\bar{y}_x = 2.94\,x^2 + 7.27x \ -1.25$$

regressiya tenglamasiga ega bo‘lamiz.

1. Berilgan korrelasion jadval asosida Y ning X ga regressiya chizig‘i $\bar{y}_x = ax^2 + bx + c$ ning tenglamasini topishda kichik kvadratlar usulida tuzilgan sistema koeffisentlarini ko‘paytmalar usulida topishning Maple dasturini tuzamiz.

M a p l e d a s t u r i:

> restart;with(stats):

1)4-*korrelasion jadval asosida X va Y larini kiritish:*

> X:=Vector([2,3,5]);

$$X := \begin{bmatrix} 2 \\ 3 \\ 5 \end{bmatrix}$$

> Y:=Vector([158,164,170,176,182]);

$$Y := \begin{bmatrix} 158 \\ 164 \\ 170 \\ 176 \\ 182 \end{bmatrix}$$

2)*korrelasion jadval asosida* n_x *va* n_{xy} *chastotalarni kiritish:*

$$nx := \begin{bmatrix} 20 \\ 31 \\ 49 \end{bmatrix}$$

```
> nx:=Vector([20,31,49]);
> nxy:=matrix([[20,0,0],[0,30,1],[0,1,48]]);
```

$$nxy := \begin{bmatrix} 20 & 0 & 0 \\ 0 & 30 & 1 \\ 0 & 1 & 48 \end{bmatrix}$$

3)*korrelasion jadval asosida shartli o 'rta qiymatlarni hisoblash:*

```
> Yx[1]:=(Y[1]*nxy[1,1]+Y[2]*nxy[2,1]+Y[3]*nxy[3,1])/nx[1];
```

$$Yx_1 := 25$$

```
> Yx[2]:=(Y[1]*nxy[1,2]+Y[2]*nxy[2,2]+Y[3]*nxy[3,2])/nx[2];
```

$$Yx_2 := \frac{1460}{31}$$

```
> evalf(%,4);
```

47.10

```
> Yx[3]:=(Y[1]*nxy[1,3]+Y[2]*nxy[2,3]+Y[3]*nxy[3,3])/nx[3];
```

$$Yx_3 := \frac{5325}{49}$$

```
> evalf(%,4);
```

108.7

4)*korrelasion jadval asosida X ning qiymatlar soni n va tanlanma xajmi N qiymatlarni kiritish:*

```
> n:=3:N:=100:
```

5)2- *jadvalning qiymatlarni ko'paytmalar usulidagi hisoblash:*

```
> Sx:=add(X[k]*nx[k],k=1..n);
```
$Sx := 378$

```
> Sxx:=add(nx[k]*X[k]^2,k=1..n);
```
$Sxx := 1584$

```
> Sxxx:=add(nx[k]*X[k]^3,k=1..n);
```
$Sxxx := 7122$

```
> Sxxxx:=add(nx[k]*X[k]^4,k=1..n);
```
$Sxxxx := 33456$

```
> SYx:=add(nx[k]*Yx[k],k=1..n);
```
$SYx := 7285$

```
> SxYx:=add(nx[k]*X[k]*Yx[k],k=1..n);
```
$SxYx := 32005$

```
> SxxYx:=add(nx[k]*X[k]^2*Yx[k],k=1..n);
```
$SxxYx := 148265$

6)*kichik kvadratlar usulida tuzilgan sistemani yechish:*

```
> abc:=solve([a*Sxxxx+b*Sxxx+c*Sxx=SxxYx,
        a*Sxxx+b*Sxx+c*Sx=SxYx,
        a*Sxx+b*Sx+c*N=SYx],{a,b,c});
```

$$abc := \left\{a = \frac{26405}{9114}, b = \frac{69365}{9114}, c = -\frac{2750}{1519}\right\}$$

```
> evalf(%,4);
```

$\{b = 7.611, c = -1.810, a = 2.897\}$

7)*regressiya egri chizig'ining tenglamasini yozish:*

> y:=abc[1]*x^2+abc[2]*x+abc[3];

$$y := x^2 a + x b + c = \frac{26405}{9114} x^2 + \frac{69365}{9114} x - \frac{2750}{1519}$$

> y:=evalf(%,4);

$$y := x^2 a + x b + c = 2.897 x^2 + 7.611 x - 1.81($$

2.Berilgan korrelasion jadval asosida Y ning X ga regressiya chizig'i $\bar{y}_x = ax^2 + bx + c$ ning tenglamasini topishda **fit** asfunksiyasidan foydalanib Maple dasturini tuzamiz.

M a p l e d a s t u r i:

> restart; with(stats):

1)1-*korrelasion jadval asosida X va Y larining qiymatlarini chastotalari bilan satr bo'yicha kiritish:*

> W:=[[Weight(2,20),Weight(3,30),Weight(5,1), Weight(3,1), Weight(5,48)], [Weight(25,20), Weight(45,30), Weight(45,1), Weight(110,1), Weight(110,48)]];

$W := [[\mathit{Weight}(2, 20), \mathit{Weight}(3, 30), \mathit{Weight}(5, 1), \mathit{Weight}(3, 1), \mathit{Weight}(5, 48)], [\mathit{Weight}(25, 20), \mathit{Weight}(45, 30), \mathit{Weight}(45, 1), \mathit{Weight}(110, 1), \mathit{Weight}(110, 48)]]$

2) *X va Y larining qiymatlari bo 'yicha (x,y) larni koordinatalar sistemasida aniqlash:*

> statplots[scatterplot](W[1],W[2],color=blue, symbol=BOX, symbolsize=20); (1-rasm)

3)*regressiya eg'ri chizig'ining tenglamasini aniqlash:*

> x:=vector(transform[statvalue](W[1]));

$$x := \begin{bmatrix} 2 & 3 & 5 & 3 & 5 \end{bmatrix}$$

> y:=vector(transform[statvalue](W[2]));

$$y := \begin{bmatrix} 25 & 45 & 45 & 110 & 110 \end{bmatrix}$$

> fit[leastsquare[[x,y],y=a*x^2+b*x+c]](W);

$$y = \frac{26405}{9114} x^2 + \frac{69365}{9114} x - \frac{2750}{1519}$$

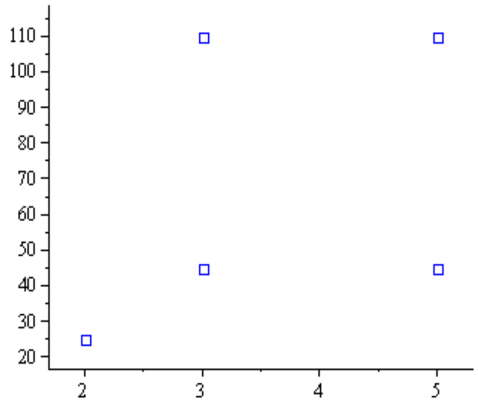
> evalf(%,5);

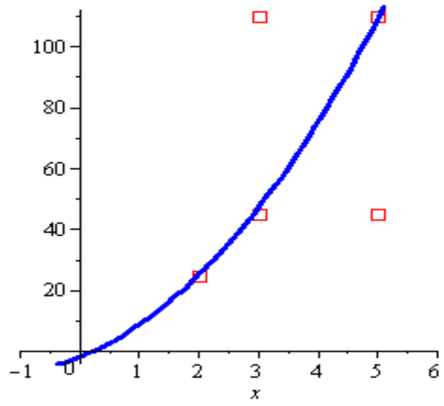
$$y = 2.8972 x^2 + 7.6108 x - 1.810\text{4}$$

4)*regressiya eg'ri chizig'ini qurish:*

> with(plots):

> plot([[x[i],y[i],i=1..5],2.8972*x^2+7.6108*x-1.8104], x=-1..6,-4..112,style=[point,line], color=[red,blue],symbol=BOX,symbolsize=25, view=[-1..6,-4..112],thickness=3); (2-rasm)





1-rasm. 2-rasm.

XULOSA. Demak, kichik kvadratlar usuli asosida topilgan ikkinchi darajali bog‘lanish-modeli adikvat bo‘lib, uning barcha koeffitsentlari qiymatdor ekanligini topdik. Berilgan tajriba natijalari bo‘yicha xulosa va qaror qabul qilish uchun topilgan tajriba natijalari bo‘yicha bog‘lanish modelni tuzish va samaradorligini aniqlashda ushbu Maple dasturidan foydalanib aniq, tez va sifatli natijalarni olish mumkinligini ko‘rdik.

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