

## 2章 データの整理

### 2節 2次元のデータ

#### 練習1

$$(1) \quad \frac{1}{5}(6+4+2+8+5) = \frac{25}{5} = 5$$

$$\begin{aligned} & \frac{1}{5}\{(6-5)^2 + (4-5)^2 + (2-5)^2 + (8-5)^2 + (5-5)^2\} \\ &= \frac{1}{5}(1+1+9+9+0) = \frac{20}{5} = 4 \end{aligned}$$

よって、分散は4

$$(2) \quad \frac{1}{8}(8+2+7+4+5+10+7+5) = \frac{48}{8} = 6$$

$$\begin{aligned} & \text{よって} \quad \frac{1}{8}\{(8-6)^2 + (2-6)^2 + (7-6)^2 + (4-6)^2 \\ & \quad + (5-6)^2 + (10-6)^2 + (7-6)^2 + (5-6)^2\} \\ &= \frac{1}{8}(4+16+1+4+1+16+1+1) = \frac{44}{8} = 5.5 \end{aligned}$$

$$(3) \quad \frac{1}{10}(7+5+2+4+3+3+5+3+6+2) = \frac{40}{10} = 4$$

$$\begin{aligned} & \text{よって} \quad \frac{1}{10}\{(7-4)^2 + (5-4)^2 + (2-4)^2 + (4-4)^2 \\ & \quad + (3-4)^2 + (3-4)^2 + (5-4)^2 + (3-4)^2 \\ & \quad + (6-4)^2 + (2-4)^2\} \\ &= \frac{1}{10}(9+1+4+0+1+1+1+1+4+4) = \frac{26}{10} = 2.6 \end{aligned}$$

#### 練習2

$$(1) \quad \bar{x} = \frac{1}{5}(1+2+4+5+8) = \frac{20}{5} = 4$$

$$\begin{aligned} \overline{x^2} &= \frac{1}{5}(1^2 + 2^2 + 4^2 + 5^2 + 8^2) \\ &= \frac{1}{5}(1+4+16+25+64) = \frac{110}{5} = 22 \end{aligned}$$

$$\text{よって、分散} \quad s^2 = \overline{x^2} - (\bar{x})^2 = 22 - 4^2 = 6$$

$$(2) \quad \bar{x} = \frac{1}{7}(1+5+7+6+2+4+10) = \frac{35}{7} = 5$$

$$\overline{x^2} = \frac{1}{7}(1+25+49+36+4+16+100) = \frac{231}{7} = 33$$

$$\text{よって、分散} \quad s^2 = 33 - 5^2 = 8$$

$$(3) \quad \bar{x} = \frac{1}{10}(8+4+6+8+2+9+7+6+4+6) = \frac{60}{10} = 6$$

$$\begin{aligned}\overline{x^2} &= \frac{1}{10}(64+16+36+64+4+81+49+36 \\ &\quad +16+36) = \frac{402}{10} = 40.2\end{aligned}$$

$$\text{よって, 分散 } s^2 = 40.2 - 6^2 = 4.2$$

### 練習 3

$$(1) \quad \bar{x} = \frac{1}{5}(1+4+7+3+5) = \frac{20}{5} = 4$$

$$\overline{x^2} = \frac{1}{5}(1+16+49+9+25) = \frac{100}{5} = 20$$

$$\therefore s = \sqrt{\overline{x^2} - (\bar{x})^2} = \sqrt{20 - 16} = \sqrt{4} = 2$$

$$(2) \quad \bar{x} = \frac{1}{8}(7+2+2+3+2+7+8+9) = \frac{40}{8} = 5$$

$$\overline{x^2} = \frac{1}{8}(49+4+4+9+4+49+64+81) = \frac{264}{8} = 33$$

よって

$$s = \sqrt{\overline{x^2} - (\bar{x})^2} = \sqrt{33 - 25} = \sqrt{8} = 2\sqrt{2} = 2.828\cdots \doteq 2.83$$

### 練習 4

階級値 $x$	度数 $f$	$xf$	$x^2f$
2	2	4	8
6	5	30	180
10	18	180	1800
14	11	154	2156
18	4	72	1296
合計	40	440	5440

$$\text{上の表より } \bar{x} = \frac{440}{40} = 11$$

$$x^2 \text{ の平均値 } \overline{x^2} \text{ は } \overline{x^2} = \frac{5440}{40} = 136$$

$$\text{よって, } x \text{ の標準偏差 } s \text{ は } s = \sqrt{136 - 11^2} = \sqrt{136 - 121} = \sqrt{15} \doteq 3.87$$

練習 5

仮平均を 65 とし、階級の幅が 10 であるから

$$u = \frac{x - 65}{10} \quad \text{によって,}$$

新しい変量  $u$  を定めると,

右の表より

$$\bar{u} = \frac{-35}{50} = -0.7$$

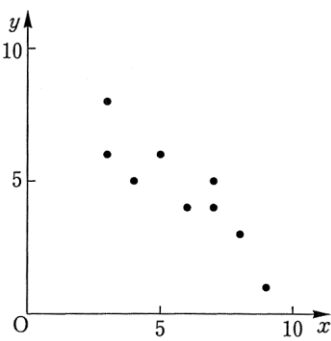
$$s_u = \sqrt{\frac{165}{50} - (-0.7)^2} = \sqrt{3.3 - 0.49}$$
$$= \sqrt{2.81} = 1.68$$

$$\text{よって } \bar{x} = 10\bar{u} + 65 = -7 + 65 = 58$$

$$s_x = 10s_u = 10 \times 1.68 = 16.8$$

$x$	$f$	$u$	$uf$	$u^2f$
5	0	-6	0	0
15	1	-5	-5	25
25	2	-4	-8	32
35	4	-3	-12	36
45	8	-2	-16	32
55	10	-1	-10	10
65	15	0	0	0
75	5	1	5	5
85	4	2	8	16
95	1	3	3	9
合計	50		-35	165

練習 6



図より、負の相関関係があるといえる。

練習 7

	45~50	50~55	55~60	60~65	65~70	70~75	合計
500~550						1	1
450~500					1		1
400~450			1				1
350~400	1	2	1				4
300~350		1					1
合計	1	3	2	0	1	1	8

練習 8

$$b : (30 - 48) \times (60 - 57) = -54 \quad \text{負}$$

$$c : (60 - 48) \times (35 - 57) = -264 \quad \text{負}$$

$$d : (50 - 48) \times (70 - 57) = 26 \quad \text{正}$$

$$e : (80 - 48) \times (90 - 57) = 1056 \quad \text{正}$$

練習 9

$$\bar{x} = \frac{1}{5}(6+5+3+2+4) = \frac{20}{5} = 4$$

$$\bar{y} = \frac{1}{5}(3+4+4+5+4) = \frac{20}{5} = 4$$

より，次の表ができる。

$x$	$y$	$x - \bar{x}$	$y - \bar{y}$	$(x - \bar{x})^2$	$(y - \bar{y})^2$	$(x - \bar{x})(y - \bar{y})$
6	3	2	-1	4	1	-2
5	4	1	0	1	0	0
3	4	-1	0	1	0	0
2	5	-2	1	4	1	-2
4	4	0	0	0	0	0
合計		0	0	10	2	-4

上の表から相関係数  $r$  は  $r = \frac{-4}{\sqrt{10} \cdot \sqrt{2}} \doteq -0.89$