2.

Item Id	1	2	3	4	5	6	Mean	P(i,2)	C(i,2)
1	5	6	7	4	3	?	5	-1	0.8692
2	4	?	3	?	5	4	4	1	1
3	?	3	4	1	1	?	2.25	-0.941	0.7071
4	7	4	3	6	?	4	4.8	0.609	0.9622
5	1	?	3	2	2	5	2.6	-0.2378	0.7898

Pearson Co-efficient.

$$P(1,2) = \frac{(0)\times(0) + (2)\times(-1) + (-2)\times(1)}{\sqrt{0+4+4} \times \sqrt{1+1}} = -4/4 = -1.$$

$$P(3,2) = \frac{0.75\times(-1) + (1)\times(-1.25)}{\sqrt{(0.75)^2 + (-1.25)^2} \times \sqrt{1+1}} = -2/2.125 = -0.941$$

$$P(4,2) = \frac{(2.2\times0)\times(-1.8)\times(-1) + (0\times-0.8)}{\sqrt{1} \times \sqrt{(2.2)^2+(1.8)^2+(0.8)}} = \frac{1.8}{2.9529} = 0.609$$

$$P(5,2) = \frac{(0\times1.6) + (-1\times0.4) + (1\times-0.6) + (0\times2.4)}{\sqrt{1+1} \times \sqrt{(1.6)^2+(0.4)^2+(0.6)^2+(2.4)^2}} = \frac{-1}{4.2047} = -0.237$$

Since we have only one positive we will take that.

Cosine - Co-efficient.

$$C(1,2) = \frac{20+21+15}{\sqrt{25+49+9} \times \sqrt{16+9+25}} = \frac{56}{64.4205} = 0.8692.$$

$$C(3,2) = \frac{12+5}{\sqrt{9+25} \times \sqrt{16+1}} = \frac{17}{24.04} = 0.707.$$

$$C(4,2) = \frac{28+9+16}{\sqrt{16+9+16} \times \sqrt{49+9+16}} = \frac{53}{55.0817} = 0.9622$$

$$C(5,2) = \frac{4+9+10+20}{\sqrt{16+9+25+16} \times \sqrt{1+9+4+25}} = \frac{43}{54.4420} = 0.7898$$

User-based approach

Raw value by Pearson's method

$$R_{21} = 4 + \frac{2.2 \times 0.609}{0.609} = 6.6$$

$$R_{24} = 4 + \frac{-0.8 \times 0.609}{0.609} = 3.2$$

Mean centered Value

Item Id	1	2	3	4	5	6
1	0	1	2	-1	-2	?
2	0	?	-1	?	1	0
3	?	0.75	1.75	-1.25	-1.25	?
4	2.2	-0.8	-1.8	1.2	?	-0.8
5	-1.6	?	0.4	-0.6	-0.6	2.4

C(2,0)	1	1	0.997	-0.9759	-0.9964	1
C(4,0)	0.7908	-0.9759	-0.975	1	0.9428	-0.707

$$C(2,1) = \frac{(0\times1) + (-0.8)\times(2.2)}{\sqrt{(2.2)^2} \times \sqrt{(0.8)^2}} = -0.45$$

$$C(2,3) = \frac{(1\times2) + (0.75\times1.75) + (-0.8 \times -1.8)}{\sqrt{1+(0.75)^2+(0.8)^2} \times \sqrt{4+(1.75)^2+(-1.8)^2}} = 0.997$$

$$C(2,4) = \frac{(1\times-1) + (0.75)\times(-1.25) + (-0.8\times1.2)}{\sqrt{1+(0.75)^2+(-0.8)^2} \times \sqrt{1+(-1.25)^2+(1.2)^2}} = -0.9759$$

$$C(2,5) = \frac{(1\times-2) + (0.75\times-1.25)}{\sqrt{1+(0.75)^2} \times \sqrt{4+(1.25)^2}} = \frac{-2.9375}{2.9481} = -0.9964$$

$$C(2,6) = \frac{-0.8\times-0.8}{\sqrt{(0.8)^2} \times \sqrt{(0.8)^2}} = 1$$

$$C(4,1) = \frac{(0\times-1) + (2.2\times1.2) + (-1.6\times-0.6)}{\sqrt{(2.2)^2+(1.6)^2} \times \sqrt{1+(1.2)^2+(0.6)^2}} = \frac{3.6}{\sqrt{7.4}\times\sqrt{2.8}} = \frac{3.6}{4.5519}$$

$$= 0.7908$$

$$C(4,3) = \frac{(2\times-1) + (1.75\times-1.25) + (-1.8\times1.2) + (0.4\times-0.6)}{\sqrt{4+(1.75)^2+(1.8)^2+(0.4)^2} \times \sqrt{1+(1.25)^2+(1.2)^2+(0.6)^2}}$$

$$= \frac{-6.5875}{6.7559} = -0.975$$

$$C(4,5) = \frac{(-1\times-2) + (-1.25\times-1.25) + (-0.6\times-0.6)}{\sqrt{1+(1.25)^2+(0.6)^2} \times \sqrt{4+(1.25)^2+(0.6)^2}} = 0.9428$$

$$C(4,6) = \frac{(1.2 \times -0.8) + (-0.6 \times 2.4)}{\sqrt{(1.2)^2 + (0.6)^2} \times \sqrt{(0.8)^2 + (2.4)^2}} = \frac{-2.4}{\sqrt{1.8} \times \sqrt{6.4}} = \frac{-2.4}{3.394}$$

$$= -0.707$$

Here for R_{22} we have to take val columns 3 & 6 so they have +ve

$$R_{22} = \frac{3 \times 0.997 + 4 \times 1}{0.997 + 1} = \frac{6.991}{1.997} = 3.5.$$

$$R_{24} = \frac{4 \times 0.7908 + 5 \times 0.9428}{0.7908 + 0.9428} = \frac{3.1632 + 4.714}{1.7336} = 4.55$$