Correlation co-efficient for bivariate frequency distribution;

If the bivariate data on x and y is given on a two way correlation table and f is the frequency of a particular rectangle in the correlation table, then,

$$r_{xy} = \frac{\sum' fxy - \frac{1}{n}\sum' fx \sum' fy}{\sqrt{\left[\sum' fx^2 - \frac{1}{n}(\sum' fx)^2\right]}\sqrt{\left[\sum' fy^2 - \frac{1}{n}(\sum' fy)^2\right]}}$$

In this case also, if we change the scale and origin, then,

$$r_{xy} = r_{uv} = \frac{\sum' fuv - \frac{1}{n}\sum' fu \sum' fv}{\sqrt{\left[\sum' fu^2 - \frac{1}{n}(\sum' fu)^2\right]}\sqrt{\left[\sum' fv^2 - \frac{1}{n}(\sum' fv)^2\right]}}$$

Ex:-> Find the co-efficient of rank correlation for the following frequency distribution.

X \ Y	10 - 25	25 - 40	40 - 55
0 - 20	10	4	6
20 - 40	5	40	9
40 - 60	3	8	15

Sol^n We make the following table.

Here, we take, $u = \frac{x-30}{20}$, $v = \frac{y-32\cdot5}{15}$.

x	Mid value	u \ v	y: 10-25	25-40	40-55	f_x	fu	fu^2	fuv
		Mid value	17·5	32·5	47·5				
		v	-1	0	1				
0-20	10	-1	$\boxed{1}$ 10 $\boxed{10}$	$\boxed{0}$ 4 $\boxed{0}$	$\boxed{-1}$ 6 $\boxed{-6}$	10+4+6 = 20	-20	20	10+0-6 = 4
20-40	30	0	$\boxed{0}$ 5 $\boxed{0}$	$\boxed{0}$ 40 $\boxed{0}$	$\boxed{0}$ 9 $\boxed{0}$	5+40+9 = 54	0	0	0+0+0 = 0
40-60	50	1.	$\boxed{-1}$ 3 $\boxed{-3}$	$\boxed{0}$ 8 $\boxed{0}$	$\boxed{1}$ 15 $\boxed{15}$	3+8+15 = 26	26	26	-3+0+15 = 12
		f_y	10+5+3 = 18	4+40+8 = 52	6+9+15 = 30	N = 100	$\Sigma' fu$ = 6	$\Sigma' fu^2$ = 46	$\Sigma' fuv$ = 16
		fv	-18	0	30	$\Sigma' fv$ = 12			
		fv^2	18	0	30	$\Sigma' fv^2$ = 48			
		fuv	10+0-3 = 7	0+0+0 = 0	-6+0+15 = 9	$\Sigma' fuv$ = 16			

We must have $\Sigma' fuv = \Sigma' fvu$

$$\therefore r_{xy} = \frac{\Sigma' fuv - \frac{1}{n}\Sigma' fu \, \Sigma' fv}{\sqrt{\Sigma' fu^2 - \frac{1}{n}(\Sigma' fu)^2}\sqrt{\Sigma' fv^2 - \frac{1}{n}(\Sigma' fv)^2}}$$

$$= \frac{16 - \frac{1}{100} \times 6 \times 12}{\sqrt{46 - \frac{1}{100} \times 36}\sqrt{48 - \frac{1}{100} \times 144}} = \cdot33$$