1) Step Deviation Method.
2) Correlation for Grouped data.

1) Step Deviation Method:

Step-wise explanation:
Let x and y be any two independent variables (Given)

Step-1: Find $\bar{x}$ and $\bar{y}$

Step-2: Construct a table:

x	y	$x_i - \bar{x}$	$y_i - \bar{y}$	$(x_i - \bar{x})^2$	$(y_i - \bar{y})^2$	$(x_i - \bar{x})(y_i - \bar{y})$

Step-3: Find $\Sigma\left(x_i - \bar{x}\right)^2$, $\Sigma\left(y_i - \bar{y}\right)^2$ and $\Sigma\left(x_i - \bar{x}\right)\left(y_i - \bar{y}\right)$

Step-4: Apply the below given formula for find the value of r

$$r = \frac{\sum(x - \bar{x})\,(y - \bar{y})}{\sqrt{\sum(x - \bar{x})^2}\sqrt{\sum(y - \bar{y})^2}}$$

- **Properties of the coefficient of correlation.**
  (1) The coefficient of correlation always lies between -1 and 1 including -1 and 1.
  i.e. $-1 \le r \le 1$
  (2) The correlation coefficient is independent of change of origin and scale.
  (3) The correlation coefficient is an absolute number and it is independent of units of measurements.

- **Remarks:** From the values of r ,we have a following observations:

$r = +1 \Rightarrow$ Perfect positive correlation.
$r = -1 \Rightarrow$ Perfect negative correlation.
$r = 0 \Rightarrow$ No Correlation.
$r =$ near to $+1 \Rightarrow$ Strong positive correlation.
$r =$ near to $-1 \Rightarrow$ Strong negative correlation.

Example 1: Find the Pearson's Correlation Coefficient of the following data:

x	100	101	102	102	100	99	97	98	96	95
y	98	99	99	97	95	92	95	94	90	91

Solution:

Step-1:

$$\bar{x} = \frac{\sum x}{n} = \frac{990}{10} = 99$$

$$\bar{y} = \frac{\sum y}{n} = \frac{950}{10} = 95$$

Step-2: Construction of table

x	y	$x-\bar{x}$	$y-\bar{y}$	$(x-\bar{x})^2$	$(y-\bar{y})^2$	$(x-\bar{x})(y-\bar{y})$
100	98	1	3	1	9	3
101	99	2	4	4	16	8
102	99	3	4	9	16	12
102	97	3	2	9	4	6
100	95	1	0	1	0	0
99	92	0	-3	0	9	0
97	95	-2	0	4	0	0
98	94	-1	-1	1	1	1
96	90	-3	-5	9	25	15
95	91	-4	-4	16	16	16
$\sum x$ =990	$\sum y$ =950	$\sum(x-\bar{x})$ =0	$\sum(y-\bar{y})$ =0	$\sum(x-\bar{x})^2$ =54	$\sum(y-\bar{y})^2$ =96	$\sum(x-\bar{x})(y-\bar{y})$ =61

Step-3: From table:

$\sum(x-\bar{x})^2 = 54$, $\sum(y-\bar{y})^2 = 96$ and $\sum(x-\bar{x})(y-\bar{y}) = 61$

Step-4: *Correlation Coefficient* , $r = \dfrac{\sum(x-\bar{x})(y-\bar{y})}{\sqrt{(x-\bar{x})^2}\sqrt{(y-\bar{y})^2}} = \dfrac{61}{\sqrt{54}\sqrt{96}} = 0.85$

Since, the value of r is near to +1, we can say that there is a strong positive correlation between the variables.

Example 2: The data below gives the marks obtained by 10 students taking Math's and Physics tests of 30 marks.

Students	A	B	C	D	E	F	G	H	I	J
MATHS (x)	20	23	8	29	14	11	11	20	17	17
PHYSICS (y)	30	35	21	33	33	26	22	31	33	36

Is there a connection between the marks gained by 10 students in Maths and Physics tests?

Solution: