Comparison of correlation method with the method for convolution.

(1) both time-domain

(2) similar mathematical definition (i.e. sum of products)

(3) in convolution folding is required.

(4) in correlation folding is not required.

We find that $r_{xy}(l) = x(n) \Diamond y(n)$

$$= x(n) * y(-n)$$

Example 1.19:

Determine the cross-correlation of the sequences.

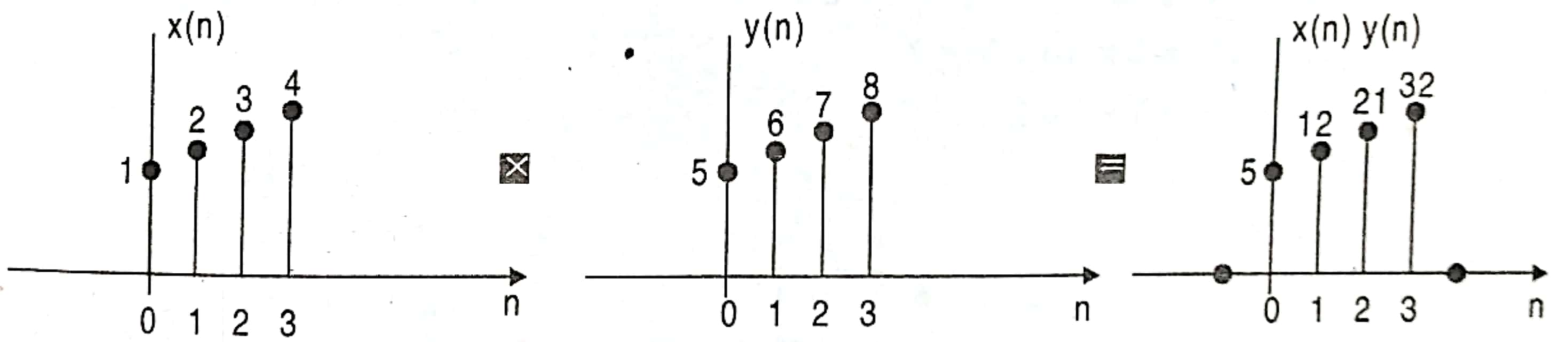
$$x(n) = \{1, 2, 3, 4\}$$

$$y(n) = \{5, 6, 7, 8\}$$

$$r_{xy}(l) = \sum_{n=-\infty}^{\infty} x(n)\, y(n-l)$$

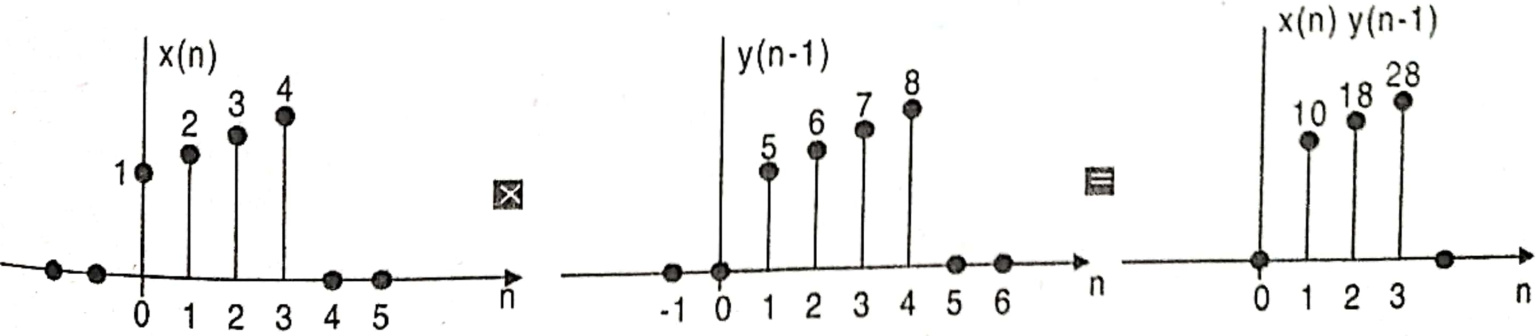
$$r_{xy}(0) = \Sigma\, x(n)\, y(n)$$

$$= 1 \times 5 + 2 \times 6 + 3 \times 7 + 4 \times 8$$



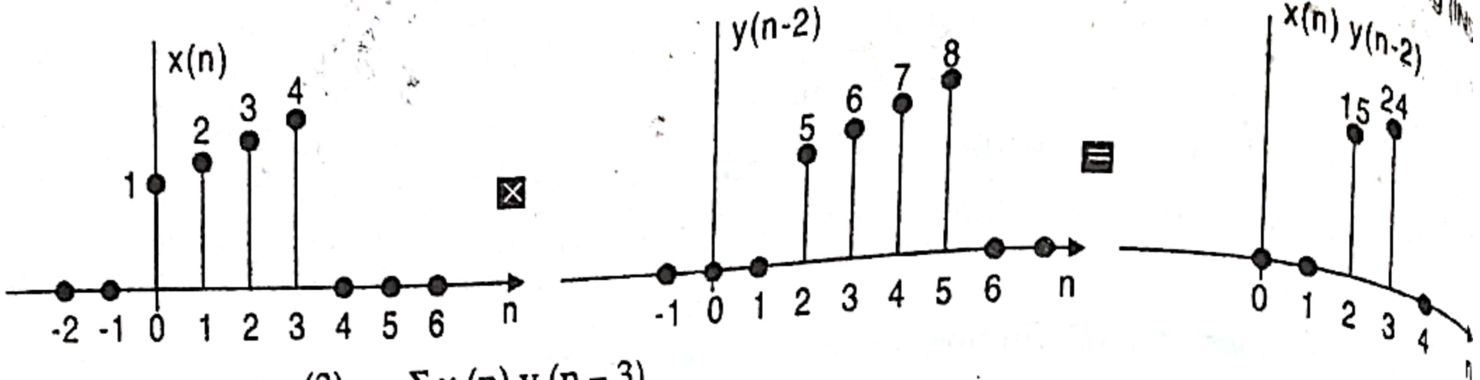
$$r_{xy}(1) = \Sigma\, x(n)\, y(n-1)$$

$$= 2 \times 5 + 3 \times 6 + 4 \times 7$$

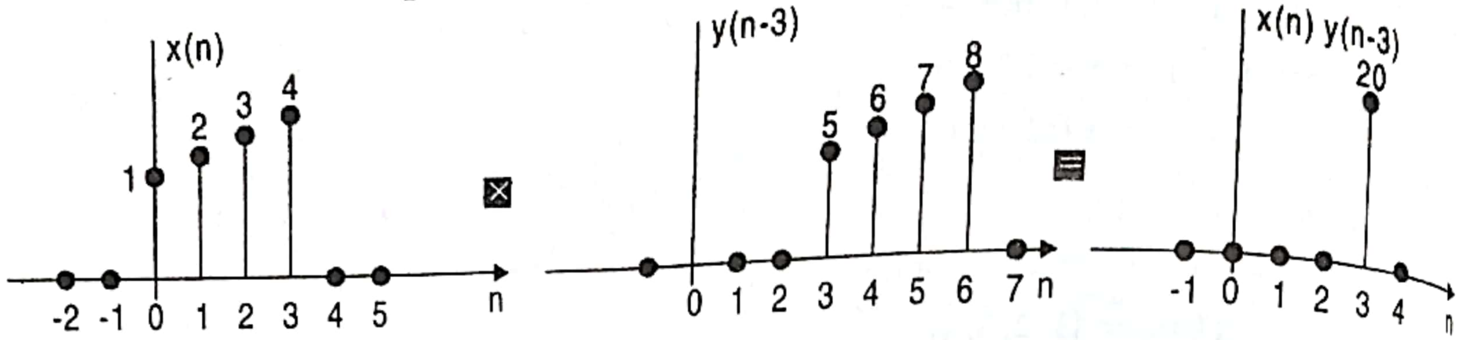


$$r_{xy}(2) = \Sigma\, x(n)\, y(n-2)$$

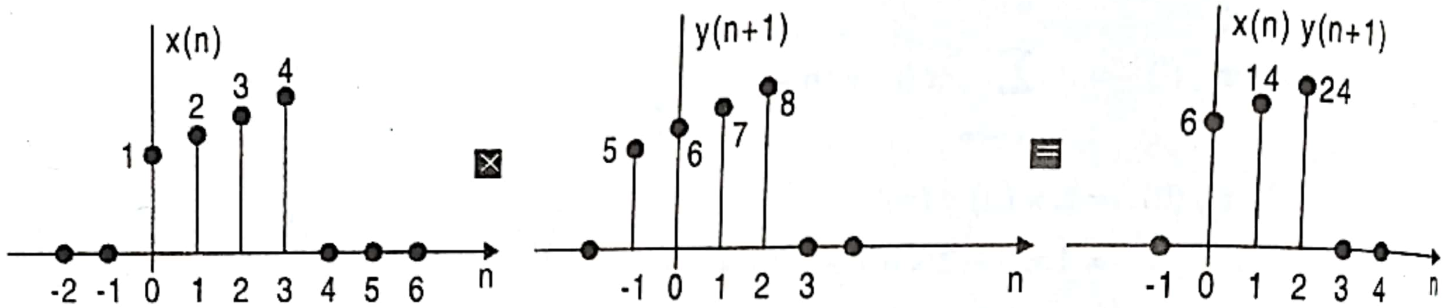
$$= 3 \times 5 + 4 \times 6$$



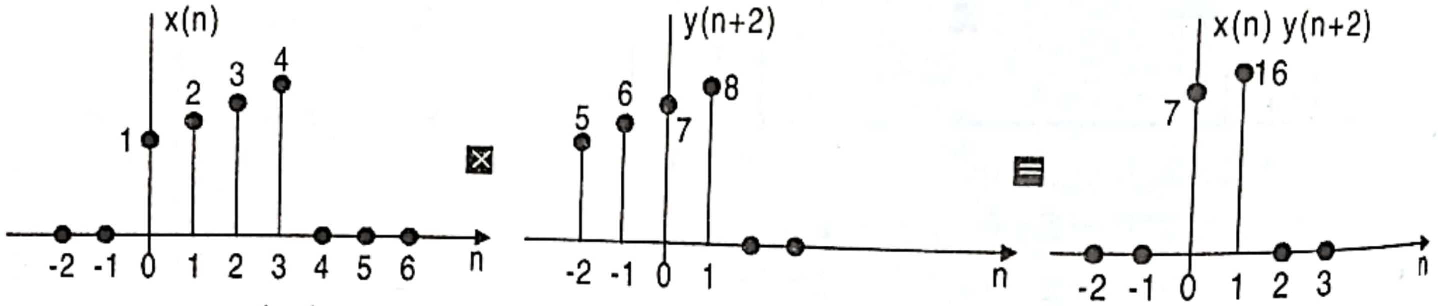
$$r_{xy}(3) = \Sigma\, x(n)\, y(n-3)$$
$$= 4 \times 5$$



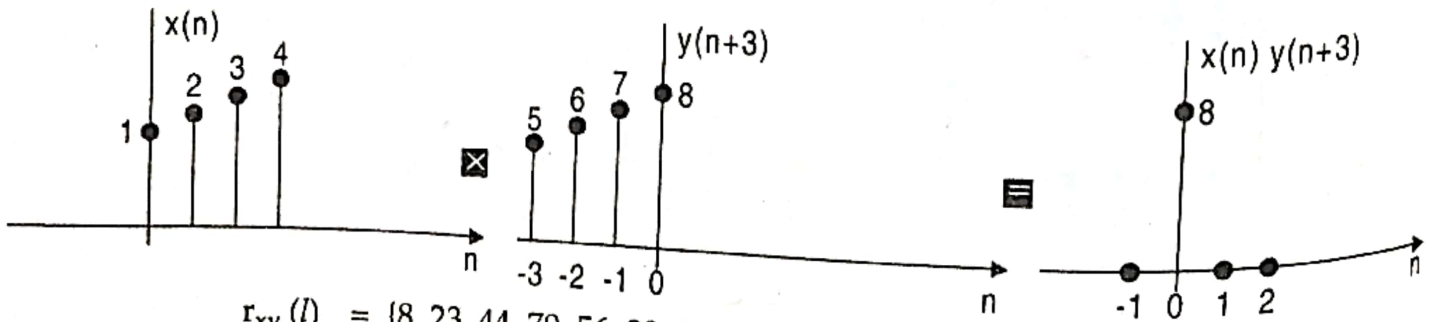
$$r_{xy}(-1) = \Sigma\, x(n)\, y(n+1)$$
$$= 1 \times 6 + 2 \times 7 + 3 \times 8$$



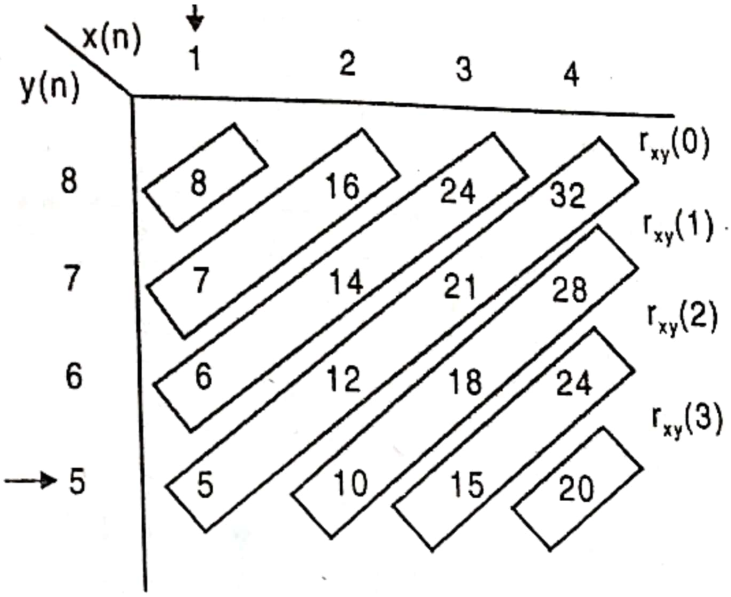
$$r_{xy}(-2) = \Sigma\, x(n)\, y(n+2)$$
$$= 1 \times 7 + 2 \times 8$$



$$r_{xy}(-3) = \Sigma\, \dot{x}(n)\, y(n+3)$$
$$= 1 \times 8$$



$$r_{xy}(l) = \{8, 23, 44, \underset{\uparrow}{70}, 56, 39, 20\}$$



Example 1.20:

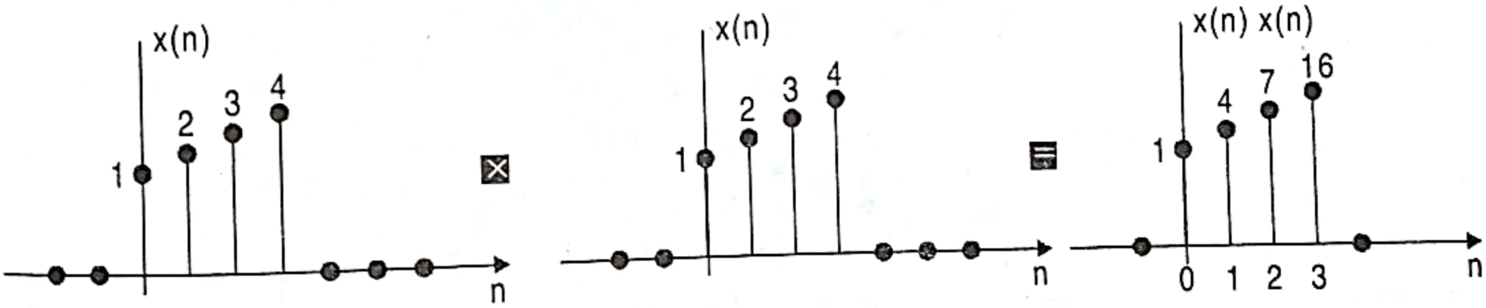
Perform auto correlation

$$x(n) = \{1, 2, 3, 4\}$$

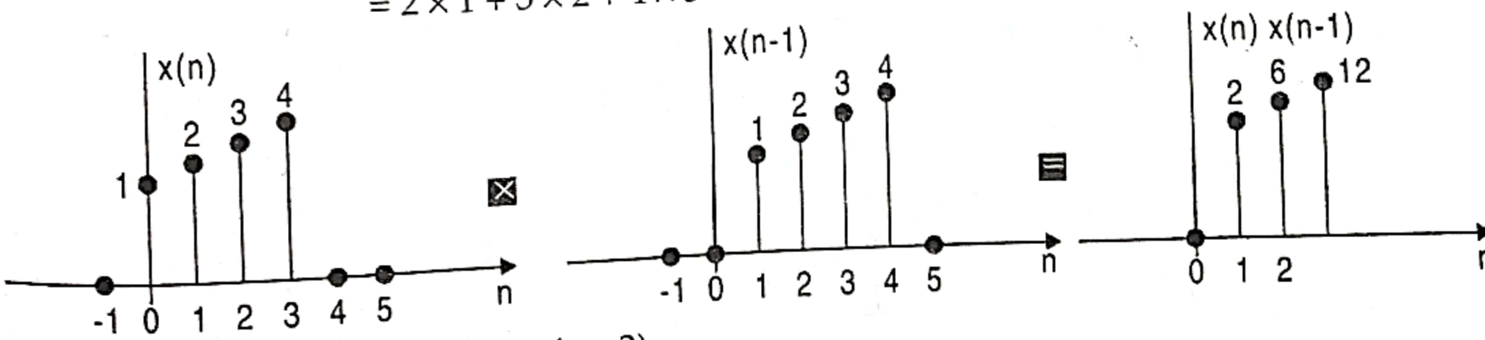
Solution:

$$r_{xx}(l) = \sum_{n=-\infty}^{\infty} x(n-l)$$

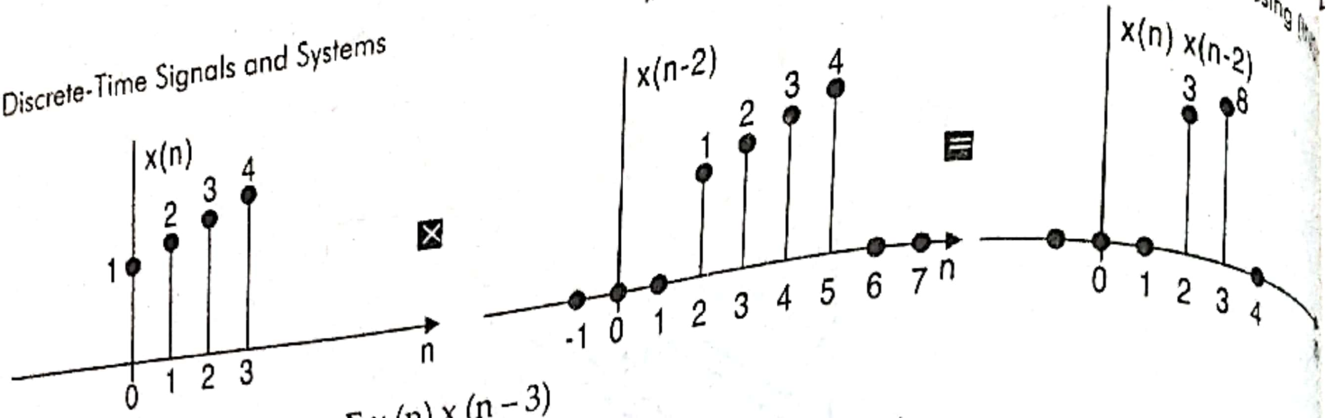
$$r_{xx}(0) = \Sigma\, x(n)\, x(n)$$
$$= 1\times1 + 2\times2 + 3\times3 + 4\times4$$
$$= 30$$



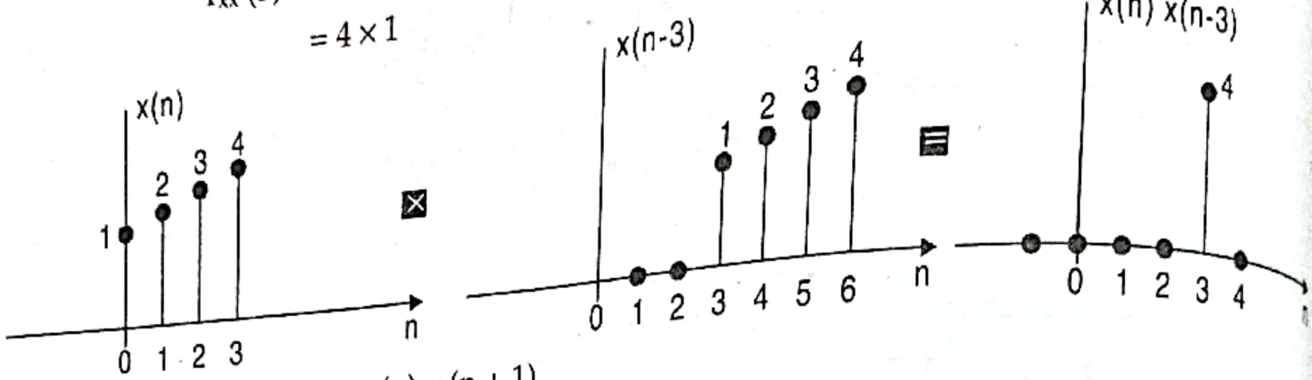
$$r_{xx}(1) = \Sigma\, x(n)\, x(n-1)$$
$$= 2\times1 + 3\times2 + 4\times3$$



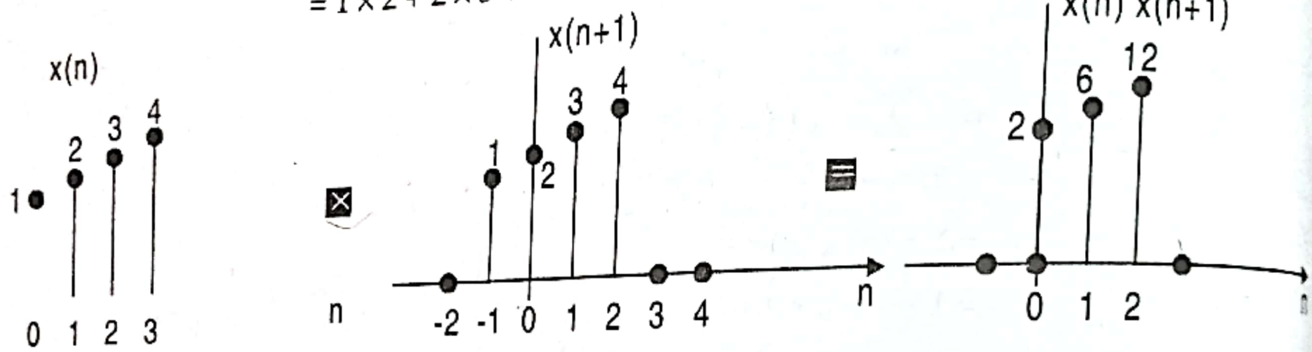
$$r_{xx}(2) = \Sigma\, x(n)\, x(n-2)$$
$$= 3\times1 + 4\times2$$



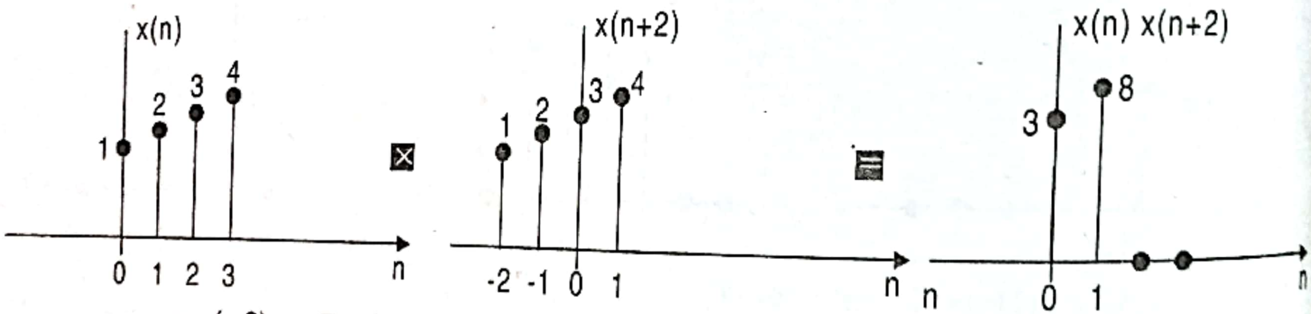
$$r_{xx}(3) = \Sigma\, x(n)\, x(n-3)$$
$$= 4 \times 1$$



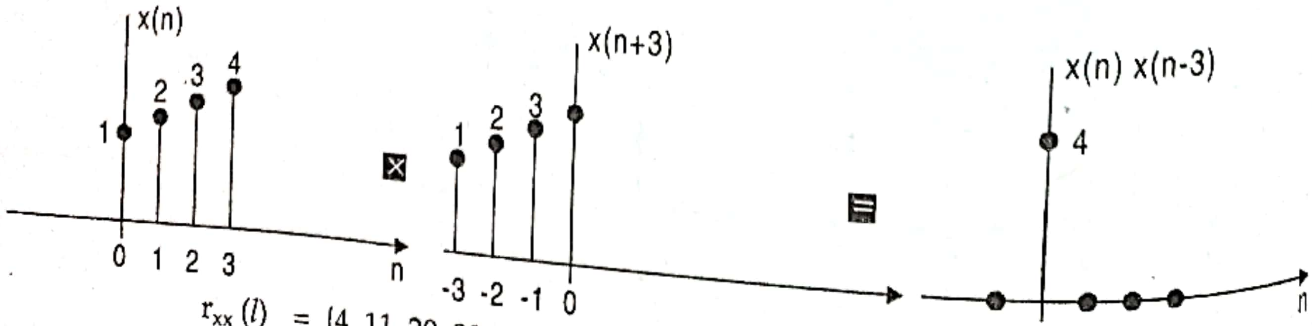
$$r_{xx}(-1) = \Sigma\, x(n)\, x(n+1)$$
$$= 1 \times 2 + 2 \times 3 + 3 \times 4$$



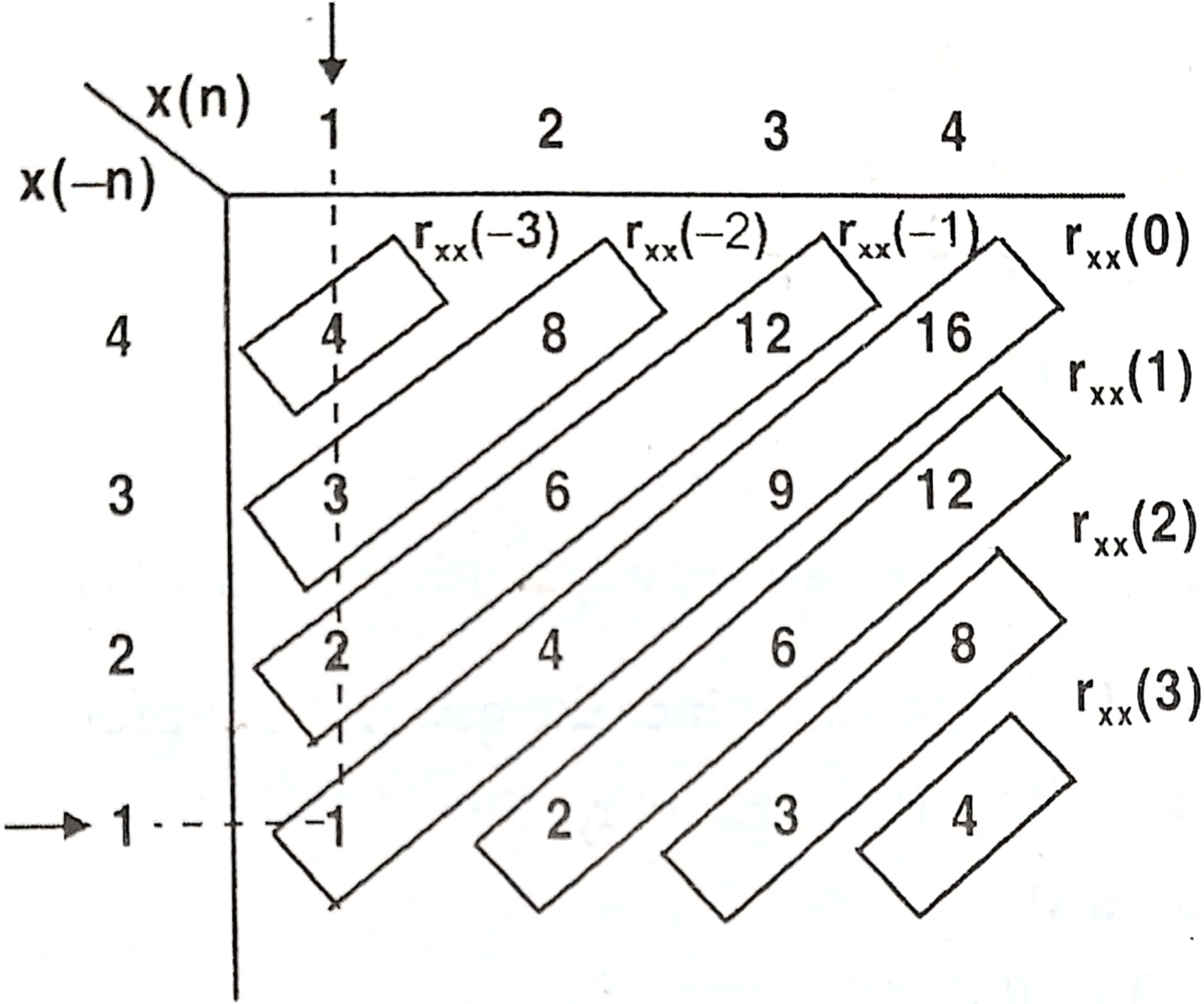
$$r_{xx}(-2) = \Sigma\, x(n)\, x(n+2)$$
$$= 1 \times 3 + 2 \times 4$$



$$r_{xx}(-3) = \Sigma\, x(n)\, x(n+3)$$
$$= 1 \times 4$$



$$r_{xx}(l) = \{4, 11, 20, 30, 20, 11, 4\}$$
$$\uparrow$$



x(n)
1
2
3
4
x(−n)
4
3
2
1
rxx(−3)
rxx(−2)
rxx(−1)
rxx(0)
rxx(1)
rxx(2)
rxx(3)
4
8
12
16
3
6
9
12
2
4
6
8
1
2
3
4