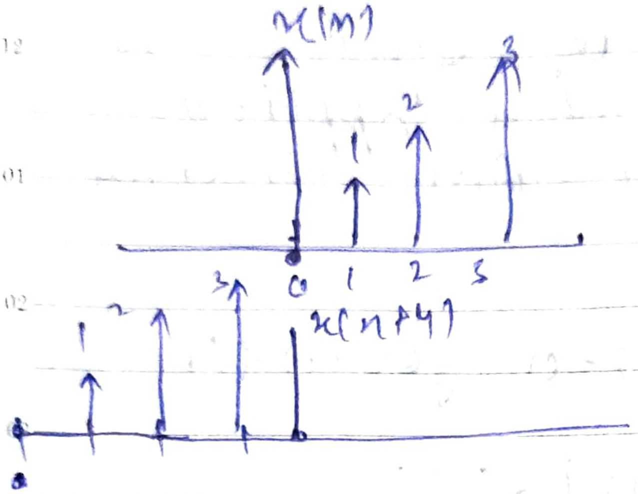
Q. Determine the autocorrelation for the sequence $x(n) = [0, 1, 2, 3]$

Sol

$$R(k) = \sum_{n=-\infty}^{\infty} x(n)\, x(n-k)$$

For $k = -4$ $\quad R(-4) = \sum_{n=-\infty}^{\infty} x(n)\, x(n+4)$

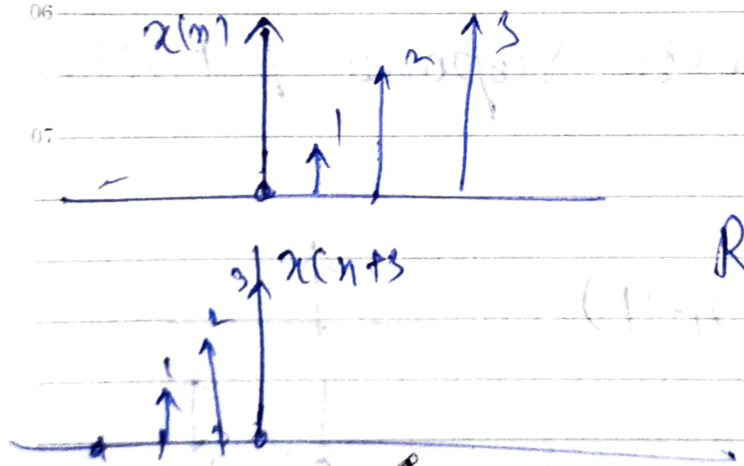


$$= \sum_{n=-\infty}^{\infty} x(n)\, x(n+4)$$

$$\sum_{n=-\infty}^{\infty} = 0$$

$$R(-4) = 0$$

$$R(-3) = \sum_{n=-\infty}^{\infty} x(n)\, x(n+3)$$



$$R(-3) \sum_{n=\infty}^{\infty} 0 = 0$$

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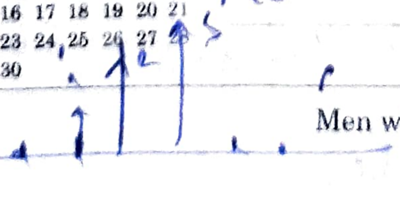
$$R(-2) = \sum_{n=-\infty}^{\infty} x(n)\, x(n+2)$$



$$0 + 0 + 0 + 3 + 0 + 0$$

$$R(-2) = 3$$

$$R(-1) = \sum_{n=-\infty}^{\infty} x(n)\cdot x(n+1)$$

$$x(0)\,x(1) + x(1)\,x(2) + x(2)\,x(3) + x(3)\cdot x(4) -$$

$$(0\times1) + (1\times2)\,(2\times3) + (3\times0)$$

$$R(-1) = 0+2+6 = 8$$

$$R(0) = \sum_{n=-\infty}^{\infty} x(n)\cdot x(n)$$

$$x(0)\cdot x(0) + x(1)\cdot x(1) + x(2)\cdot x(2) + x(3)\cdot x(3)$$

$$(0\times0)+(1\times1)+(2\times2)+(3\times3)$$

$$0+1+4+9 = 14$$

$$R(1) = \sum_{n=-\infty}^{\infty} x(n)\,x(n-1)$$

$$x(0)\,x(-1) + x(1)\,x(0) + x(2)\,x(1) + x(3)\,x(2) + x(4)\,x(3)$$

$$0 + (1\times0)+(2\times1)+(3\times2)+(0\times3) = 2+6=8$$

$$R(2) = \sum_{n=-\infty}^{\infty} x(n)\,x(n-2)$$

$$x(0)\,x(-2) + x(1)\,x(-1) + x(2)\,x(0) + x(3)\,x(1)$$

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$$R(2) = (0\times0)+(1\times0)+(2\times0)+(3\times1) = 3$$

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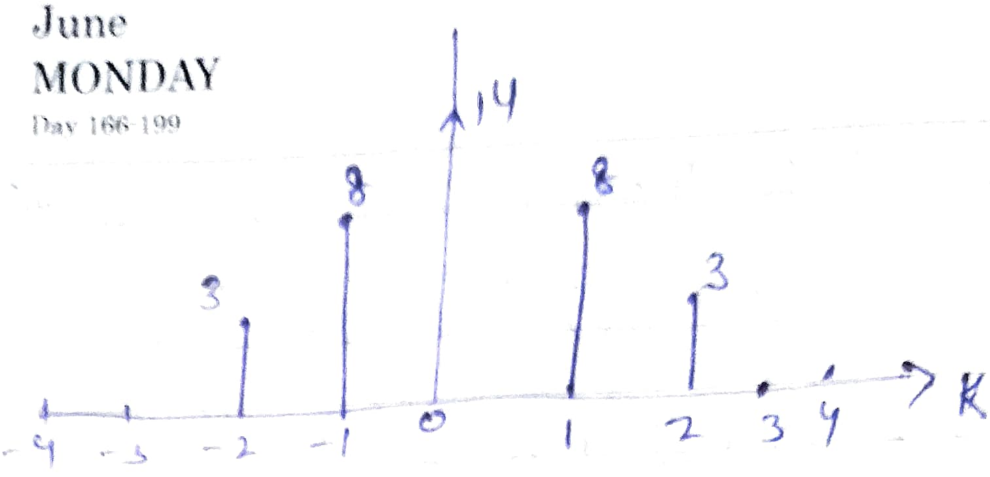
Wk	M	T	W	T	F	S	S
27			1	2	3	4	5
28	6	7	8	9	10	11	12
29	13	14	15	16	17	18	19
30	20	21	22	23	24	25	26
31	27	28	29	30	31		



$$R(3) = \sum_{n=-\infty}^{\infty} x(n)\, x(n-3)$$

$$x(0)\, x(-3) + x(1)\, x(-2) + x(2)\, x(-1) + x(3)\, x(0)$$
$$(0 \times 0) + (1 \times 0) + (2 \times 0) + (3 \times 0) = 0$$

obtain the cross correlation of the following sequences

$x_1(n) = [\underset{\uparrow}{2}, 3, 4]$ and $x_2(n) = [\underset{\uparrow}{1}, 2, 3]$

There are two methods of solving this eq

1. Direct computation method
2. Graphical method

Direct Computation method $\rightarrow$ The cross correlation is defined as

$$R_{12}(K) = \sum_{n=0}^{2} x_1(n)\, x_2(n-K)$$

Now let us obtain the value of $R_{12}(K)$ for different values of K. Since $x_1(n)$ exist from $n=0$ to $n=2$ the product term $x_1(n)\, x_2(n-K)$ will be non zero only for these values of n

$$\therefore R_{12}(k) = \sum_{n=0}^{2} x_1(n)\, x_2(n-k)$$

$R_{12}(k)$ = for -3

$$R_{12}(-3) = \sum_{n=0}^{2} x_1(n)\, x_2(n+3)$$

$$x_1(0)\,x_2(3) + x_1(1)\,x_2(4) + x_1(2)\,x_2(5)$$

$$(2\times 0) + (3\times 0) + (4\times 0) = 0$$

$$R_{12}(-2) = \sum_{n=0}^{2} x_1(n)\, x_2(n+2)$$

$$x_1(0)\,x_2(2) + x_1(1)\,x_2(3) + x_1(2)\,x_2(4)$$

$$(2\times 3) + (3\times 0) + (4\times 0) = 6$$

$$R_{12}(-1) = \sum_{n=0}^{2} x_1(n)\, x_2(n+)$$

$$x_1(0)\,x_2(1) + x_1(1)\,x_2(2) + x_1(2)\,x_2(3)$$

$$(2\times 2) + (3\times 3) + (4\times 0) = 13$$

$$R_{12}(0) = \sum_{n=0}^{2} x_1(n)\, x_2(n)$$

$$x_1(0)\,x_2(0) + x_1(1)\,x_2(1) + x_1(2)\,x_2(2)$$

$$(2\times 1) + (3\times 2) + (4\times 3) = 20$$

$$R_{12}(1) = \sum_{n=0}^{2} x_1(n)\, x_2(n-1)$$

$$x_1(0)\,x_2(-1) + x_1(1)\,x_2(0) + x_1(2)\,x_2(1)$$

$$(2\times 0) + (3\times 1) + (4\times 2) = 11$$

$$R_{12}(2) = \sum_{n=0}^{2} x_1(n)\, x_2(n-2)$$

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$$x_1(0)\,x_2(-2) + x_1(1)\,x_2(-1) + x_1(2)\,x_2(0)$$

$$(2\times 0) + (3\times 0) + (4\times 1) = 4$$

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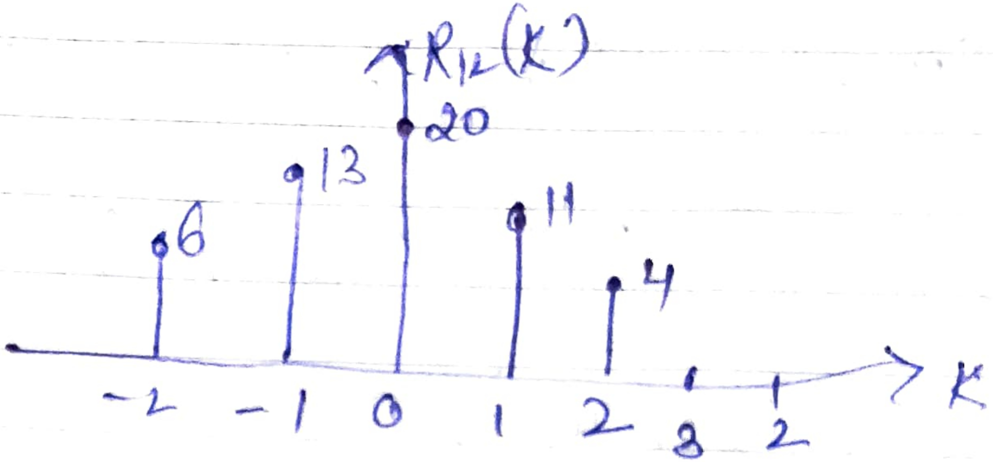
31	27	28	29	30	31		

08 $$R_{12}(3) = \sum_{n=0}^{2} x_1(n)\, x_2(n-3)$$

09 $$x_1(0)\, x_2(-3) + x_1(1)\, x_2(-2) + x_1(2) \cdot x_2(-1)$$

$$(2\times 0) + (3\times 0) + (4\times 0) = 0$$



01 $$R_{12}(k) = \{6,\ \underset{}{13},\ \underset{\uparrow}{20},\ 11,\ 4\}$$

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