Maths Assignment

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Problem Statement

A G.P consists of an even number of terms. If the sum of all terms is 5 times the sum of terms occupying odd places, then find its common ratio.

Solution

Parameter	Description	condition
n	Number of terms in the G.P	-
m	natural number	n=2m
$x(0)$	first term in the G.P	-
r	common ratio in the G.P	-
$x(n)$	$n+1$ th term in the G.P	$x(n) = x(0)r^n$
$y(n)$	sum of G.P series	$y(n) = x(0)\left(\frac{r^{n+1}-1}{r-1}\right)u(n)$
$w(n)$	sum of terms in odd places	$w(n) = x(0)\left(\frac{r^{n+1}-1}{r^2-1}\right)u(n)$

TABLE I
Input Parameters

Solving the Question in time domain:

$$n = 2m \tag{1}$$

$$x(n) = x(0)r^{2m} \tag{2}$$

$$y(n) = x(0)\left(\frac{r^{2m+1}-1}{r-1}\right)u(2m) \tag{3}$$

The sum of terms in odd places:

$$w(n) = x(0)\left(\frac{r^{2m+1}-1}{r^2-1}\right)u(2m) \tag{4}$$

Then from (3) and (4)

$$x(0)\left(\frac{r^{2m+1}-1}{r-1}\right)u(2m) = 5\left(x(0)\left(\frac{r^{2m+1}-1}{r^2-1}\right)u(2m)\right) \tag{5}$$

$$\frac{r^2-1}{r-1} = 5 \tag{6}$$

$$\text{as } r \neq 1, \quad \text{hence } r = 4 \tag{7}$$

$$\tag{8}$$

X,Y,Z are frequency counterparts of the above GP

$$X(z) = \frac{x(0)}{1-rz^{-1}} \quad |z| > |r| \tag{9}$$

$$Y(z) = \frac{x(0)}{(1-rz^{-1})(1-z^{-1})} \tag{10}$$

$$W(z) = \frac{x(0)}{\left(1-rz^{\frac{-1}{2}}\right)(1-z^{-1})} \tag{11}$$