On the system of rational difference equations

Abdullah Selçuk Kurbanli

Selcuk University, Faculty of Engıneerıng, Department of Metallurgical and Materials Engineering, 42130 Konya, Turkey,

akurbanli42@gmail.com

Abstract: In this paper, we study the following system of difference equations for $n \in \mathbb{N}_0$

$$\left\{ \begin{array}{l} x_{n+1} = \frac{x_{n-1}}{y_n x_{n-1} - 1}, \\ y_{n+1} = \frac{y_{n-1}}{x_n y_{n-1} - 1}, \\ z_{n+1} = x_n y_n z_{n-1}, \end{array} \right. \tag{1}$$

where x_0, x_{-1}, y_0, y_{-1}, z_0, z_{-1} real numbers such that $y_0 x_{-1} \neq 1$ and $x_0 y_{-1} \neq 1$.

Theorem 1. *Let $y_0 = a$, $y_{-1} = b$, $x_0 = c$, $x_{-1} = d$, $z_0 = e$, $z_{-1} = f$ be real numbers such that $ad \neq 1$ and $cb \neq 1$. Let $\{x_n, y_n, z_n\}$ be a solution of the system (1). Then all solutions of (1) are*

$$x_n = \left\{ \begin{array}{ll} \frac{d}{(ad-1)^n}, & \text{n} - \text{odd}, \\ c(cb-1)^n, & \text{n} - \text{even} \end{array} \right. \tag{2}$$

$$y_n = \left\{ \begin{array}{ll} \frac{b}{(cb-1)^n}, & \text{n} - \text{odd}, \\ a(ad-1)^n, & \text{n} - \text{even} \end{array} \right. \tag{3}$$

$$z_n = \left\{ \begin{array}{ll} (ca)^n f[(cb-1)(ad-1)]^{\sum_{i=0}^{n-1} i}, & \text{n} - \text{odd}, \\ \frac{d^n b^n e}{[(ad-1)(cb-1)]^{\sum_{i=1}^{n} i}}, & \text{n} - \text{even} \end{array} \right. \tag{4}$$

References

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