

INFINITE SUMS OF WEIGHTED FIBONACCI NUMBERS OF ORDER k

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ABSTRACT. For integers $m \geq 0$ and $k \geq 2$, set $\alpha_{m,k} := \sum_{n=0}^{\infty} \frac{n^m r^{k(n+1)}}{2^{n+1}}$, where $F_n^{(k)}$ is the Fibonacci sequence of order k or k -generalized Fibonacci sequence. It is shown that $\alpha_{0,k} = 1$, $\alpha_{1,k} = 2^{k+1} - k - 1$, $\alpha_{2,k} = 2^{k+1}(2^{k+2} - 4k - 3) + k^2 + 2k - 1$, and $\alpha_{m,k} = 1 + \sum_{r=0}^{m-1} \binom{m}{r} \sum_{s=1}^k 2^{s-1} r^{m-r} \alpha_{r,k}$, which generalize recent results on weighted Fibonacci sums by Benjamin, Neer, Otero, and Sellers.

1. INTRODUCTION AND MAIN RESULTS

Benjamin et al. [1] investigated sums of the form

$$\alpha_m := \sum_{n=1}^{\infty} \frac{n^m F_n}{2^{n+1}}, \quad m = 0, 1, 2, \dots \quad (1.1)$$

by probabilistic arguments. They found that

$$\alpha_0 = 1, \alpha_1 = 5, \alpha_2 = 47, \quad (1.2)$$

and

$$\alpha_m = 1 + \sum_{r=0}^{m-1} \binom{m}{r} (2 + 2^{m-r}) \alpha_r, \quad (1.3)$$

which implies $\alpha_3 = 665$, $\alpha_4 = 12551$, and so on (see, also, Vajda [11]). Here and in the sequel $\sum_{j=l}^n f_j = 0$, for $l > n$.

Presently, we examine sums of the form

$$\alpha_{m,k} := \sum_{n=1}^{\infty} \frac{n^m F_n^{(k)}}{2^{n+k-1}}, \quad m = 0, 1, 2, \dots, \quad k = 2, 3, \dots, \quad (1.4)$$

where $F_n^{(k)}$ is the Fibonacci sequence of order k [2,7,8,9,11] (or k -generalized Fibonacci sequence [4-6]).

We note first [6] that for each $k = 2, 3, \dots$,

$$\lim_{n \rightarrow \infty} \frac{F_{n+2}^{(k)}}{F_n^{(k)}} = r_{k,k}$$

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