

# Double-Recurrence Fibonacci Numbers and Generalizations

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## Abstract

Let  $(F_n)_{n \geq 0}$  be the Fibonacci sequence given by the recurrence  $F_{n+2} = F_{n+1} + F_n$ , for  $n \geq 0$ , where  $F_0 = 0$  and  $F_1 = 1$ . There are several generalizations of this sequence and also several interesting identities. In this paper, we investigate a homogeneous recurrence relation that, in a way, extends the linear recurrence of the Fibonacci sequence for two variables, called *double-recurrence Fibonacci numbers*, given by  $F(m, n) = F(m-1, n-1) + F(m-2, n-2)$ , for  $n, m \geq 2$ , where  $F(m, 0) = F_m$ ,  $F(m, 1) = F_{m+1}$ ,  $F(0, n) = F_n$  and  $F(1, n) = F_{n+1}$ . We exhibit a formula to calculate the values of this double recurrence, only in terms of Fibonacci numbers, such as certain identities for their sums are outlined. Finally, a general case is studied.