Reformulation: Summation of Some Polygamma Functions at Negative Integer Values

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ABSTRACT

In this paper we consider the summation of some Polygamma[n, f(x)] function from interval x equals to N_1 to interval x equals to N_2, where the value of f(x) along this interval includes some negative or asymptotically negative integer values. We also consider a normalized signal function that is continous and differentiable across all real domain unlike the sinc(x) function.

OUTLINE

INTRODUCTION

Closed form partial summations of some elementary and non-elementary mathematical functions f(x,y) tend to resolve into non-polynomial functions comprising of the Polygamma, Factorial and other closely related functions g(y). These new functions when their x values are positive can be approximated by Maclaurin, Taylor and other series expansion methods at a specific value or at infinity. At negative values of x these functions can be expressed in terms of their positive values, and the co-tangent function or closely associated functions, which tend to positive or negative infinity at some or all integer values and that are discontinuous.

Let f(x,y) = 1/(x + y)

Sum[f(x,y), {x, 1, N}, {y, 1, N}] = Sum[Polygamma[1,y], {y, 1, N}] - Expression(1)

Where; g(y) = Polygamma[1,y]

Let f_a(x,y) = 1/(x - y)

Sum[f_a(x,y), {x, 1, N}, {y, 1, N}] = Sum[Polygamma[1, -y], {y, 1, N}] - Expression(2)

Where; g_a(y) = Polygamma[1,-y]

Expression(1) & Expression(2) above are both very simple cases of functions f(x), which when partially summed resolve into new functions g(y) comprising or wholly composed of Polygamma functions with positive variables and Polygamma functions with negative variables respectively.

GAMMA & POLYGAMMA FUNCTION

Let g(y) = Polygamma[1,y]

Taylor Series Expansion of g(y) at infinity =

Let g_a(y) = Polygamma[1,-y]

g_a (y) = Polygamma[1,y] + 1/y + (Pi * y * Cot[Pi * y])

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CONCLUSION

In conclusion

REFERENCES

1).