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Bernoulli polynomials, let us start

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with the sum that we want to evaluate viz.,  $\sum_{k=0}^{\infty} \frac{x^k}{k!}$ . Evidently,  $\frac{x^k}{k!}$  is the coefficient of  $x^k$  in the power series expansion of  $e^x = 1 + x + \frac{x^2}{2!} + \frac{x^3}{3!} + \dots$ . In other words,

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In particular, the first value turns out to be “the same” as the 240 240 arising from the theory of Bernoulli numbers

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and the zeta function, and thus should be “the same” as the one appearing in the image of the  $J$  homomorphism: the others are also related to  $24$  and  $2$ , but in a more indirect way.

*Bernoulli Numbers and the  $J$ -  
homomorphism | The  $n$ -Category Café*

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Published 2013/9/15 Bernoulli numbers are the coefficients of the formula of a sum of powers of natural numbers. For example, a formula of a sum of natural numbers can be expressed by two Bernoulli numbers. Zeta function can be expressed by these Bernoulli numbers.

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*Zeta function and Bernoulli numbers -  
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The Bernoulli numbers can be expressed in terms of the Riemann zeta function:  $B_n = -\frac{1}{n} \zeta(1-n)$  for  $n \geq 1$  .. Here the argument of the zeta function is 0 or negative. By means of

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the zeta functional equation and the gamma reflection formula the following relation can be obtained (Arfken 1970, p. 279):  $\zeta(1-n) = -\frac{B_n}{n}$  for  $n \geq 1$ . Now the argument of the zeta function is positive.

*Bernoulli number - Wikipedia*

*Page 23/74*

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The Bernoulli numbers  $B_n$  are a sequence of signed rational numbers that can be defined by the exponential generating function  $x/(e^x-1) = \sum_{n=0}^{\infty} (B_n x^n)/(n!)$ . (1) These numbers arise in the series expansions of trigonometric functions, and are extremely important in number



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theory and analysis. There are actually two definitions for the Bernoulli numbers.

*Bernoulli Number -- from Wolfram  
MathWorld*

Since this discovery, the Bernoulli numbers have appeared in many

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important results, including the series expansions of trigonometric and hyperbolic trigonometric functions, the Euler-Maclaurin Summation Formula, the evaluation of the Riemann zeta function, and Fermat's Last Theorem. This primer is intended to spark the reader's interest.

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*The Bernoulli Numbers: A Brief Primer*

The Riemann zeta function or

Euler–Riemann zeta function,  $\zeta(s)$ , is a function of a complex variable  $s$  that analytically continues the sum of the Dirichlet series  $\sum_{n=1}^{\infty} n^{-s}$ , which converges when the real part of  $s$  is

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greater than 1. More general representations of  $\zeta(s)$  for all  $s$  are given below. The Riemann zeta function plays a pivotal role in analytic number theory and has applications ...

*Riemann zeta function - Wikipedia*

MULTIPLE ZETA VALUES, POLY-

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BERNOULLI NUMBERS, AND  
RELATED ZETA FUNCTIONS  
TSUNEO ARAKAWA and  
MASANOBU KANEKO Abstract.

We study the function  $(k_1; \dots; k_n; s) = \sum_{0 < m_1 < m_2 < \dots < m_n} \frac{1}{k_1^{m_1} \dots k_n^{m_n} s^{m_1 + \dots + m_n}}$  and show that the poly-Bernoulli numbers introduced in our previous

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paper are expressed as special values  
at negative arguments of certain ...

*MULTIPLE ZETA VALUES, POLY-  
BERNOULLI NUMBERS, AND  
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That Bernoulli numbers are firmly  
embedded in analytic number theory is

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guaranteed by their relationship to reciprocal power sums, otherwise known as values of the Riemann Zeta function. Half of this relationship was already known to Euler.

*Bernoulli numbers and the unity of mathematics*

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The author made one such attempt with late Arakawa in the hope of finding a nice zeta function which connects poly-Bernoulli numbers with the so-called multiple zeta values, the subject of wide interest not only in number theory but also in numerous other branches such as topology,



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quantum groups, arithmetic geometry, mathematical physics etc.

*Poly-Bernoulli numbers and related zeta functions*

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integers. The real reason that they are indispensable for number theory, however, lies in the fact that special values of the Riemann zeta function can be written by using Bernoulli numbers.

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This is the first introductory book on multiple zeta functions and multiple polylogarithms which are the generalizations of the Riemann zeta function and the classical polylogarithms, respectively, to the

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Zeta and q-Zeta Functions and

*Page 59/74*

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1997 is generalized to a more general form here.

The author demonstrates that the Dirichlet series representation of the Riemann zeta function converges geometrically at the roots in the critical strip. The Dirichlet series parts of the

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Riemann zeta function diverge everywhere in the critical strip. It has therefore been assumed for at least 150 years that the Dirichlet series representation of the zeta function is useless for characterization of the non-trivial roots. The author shows that this assumption is completely wrong.

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critical line. Hence, the Riemann hypothesis is correct. Formulae are derived and solved numerically, yielding highly accurate values of the imaginary parts of the roots of the zeta function.

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This proceedings volume is based on papers presented at the Workshops on Combinatorial and Additive Number Theory (CANT), which were held at the Graduate Center of the City University of New York in 2011 and 2012. The goal of the workshops is to



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