Math417

January 11, 2013

Programming assignment 1

Problem 1. Write a subroutine which computes the sum

$$S = 1 + \frac{1}{2^s} + \frac{1}{3^s} + ... + \frac{1}{N^s},$$

for $s = 2, 3$ and $N = 10^4, 10^5, 10^6$.

Problem 2. Write a program which prompts the user for the values of s and n, where n in an integer and $N = 10^n$ and uses the above subroutine. Use float/real type for you sum variable if you program in C, C++, or any other language. Do not use double!

Problem 3. Compute the same values but with backward summation, i.e.,

$$S = \frac{1}{N^s} + \frac{1}{(N-1)^s} + ... + \frac{1}{2^s} + 1,$$

Problem 4. Turn in a page with your results in a table arranged in the following way:

For each value of s and N, print the sums, and the difference between the forward and the backward sums. Note that if you use Matlab with double precision your forward and backward sums will be almost the same.

In the cases $s = 2$ and $s = 3$, also compare the partial sums with the infinite sum:

$$\zeta(s) = 1 + \frac{1}{2^s} + \frac{1}{3^s} + ... + \frac{1}{N^s} + ...$$

You can use:

$$\zeta(2) = 1.6449340668482264 \text{ for } s = 2,$$

$$\zeta(3) = 1.2020569031595900 \text{ for } s = 3.$$

For each value of s and N, print the differences: ζ - forward, ζ - backward, and the ratio of the two absolute errors.

Which values are closer to the "real values" of the corresponding sums and why?