Arbitrarily Accurate Computation with R: Package 'Rmpfr'

Martin Mächler[1,2,*]

1. ETH Zurich (Seminar for Statistics), Switzerland
2. R Core Development Team
*Contact author: maechler@stat.math.ethz.ch

Keywords: Arbitrary Precision, High Accuracy, Multiple Precision Floating-Point, Rmpfr

The R package **Rmpfr** allows to use arbitrarily precise numbers instead of R's double precision numbers in many R computations and functions.

This is achieved by defining S4 classes of such numbers and vectors, matrices, and arrays thereof, where all arithmetic and mathematical functions work via the (GNU) MPFR C library, where MPFR is acronym for "***M**ultiple **P**recision **F**loating-Point **R**eliably*". MPFR is Free Software, available under the LGPL license, and itself is built on the free GNU Multiple Precision arithmetic library (GMP).

Consequently, by using **Rmpfr**, you can often call your R function or numerical code with mpfr–numbers instead of simple numbers, and all results will automatically be much more accurate.

```
> options(digits = 17)# to print to full "standard R" precision
> .N <- function(.) mpfr(., precBits = 200)
> exp(   1 )

[1] 2.718281828459045

> exp(.N(1))

1 'mpfr' number of precision  200   bits
[1] 2.7182818284590452353602874713526624977572470936999595749669968
```

Applications by the package author include testing of Bessel or polylog functions and distribution computations, e.g. for stable distributions. In addition, the **Rmpfr** has been used on the `R-help` or `R-devel` mailing list for high-accuracy computations, e.g., in comparison with results from commercial software such as Maple, and in private communications with Petr Savicky about fixing R bug PR#14491.

We expect the package to be used in more situations for easy comparison studies about the accuracy of algorithms implemented in R, both for "standard R" and extension packages.

References

Fousse L, Hanrot G, Lefèvre V, Pélissier P, Zimmermann P (2011). *MPFR: A multiple-precision binary floating-point library with correct rounding.* URL http://mpfr.org/.

Granlund T, the GMP development team (2011). *GNU MP - The GNU Multiple Precision Arithmetic Library.* URL http://gmplib.org/.

Maechler M (2011). *Rmpfr: R MPFR - Multiple Precision Floating-Point Reliable.* R package version 0.4-2, URL http://rmpfr.r-forge.r-project.org/.