

# Package ‘rationalfun’

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**Title** Manipulation of Rational Functions

**Description** Functions to manipulate rational functions, including basic arithmetic operators, derivatives, and integrals with EXPLICIT forms.

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as.character.rationalfun

*Convert object to character*

---

### Description

This function converts an object of class "rationalfun" to a character string.

### Usage

```
## S3 method for class 'rationalfun'  
as.character(x, ...)
```

### Arguments

x	an object of class "rationalfun"
...	not used in this function

### Value

A character string representing the rational function.

### See Also

[as.character.polynomial](#)

### Examples

```
r <- rationalfun(c(1, 1), c(3, 2, 1))  
as.character(r)
```

---

as.function.rationalfun

*Convert object to function*

---

### Description

This function converts an object of class "rationalfun" to a function.

### Usage

```
## S3 method for class 'rationalfun'  
as.function(x, ...)
```

**Arguments**

x                    an object of class "rationalfun"  
...                   not used in this function

**Value**

A function with one argument which could be a real or complex vector.

**See Also**

[as.function.polynomial](#)

**Examples**

```
r <- rationalfun(c(1, 1), c(3, 2, 1))
r
f <- as.function(r)
f
f(1:10)
f(1:10 + (0+2i))
```

---

deriv.rationalfun        *Differentiate a rational function*

---

**Description**

Calculate the derivative of a rational function. The returned value result is still an object of class "rationalfun".

**Usage**

```
## S3 method for class 'rationalfun'
deriv(expr, ...)
```

**Arguments**

expr                   an object of class "rationalfun"  
...                    not used in this function

**Value**

An object of class "rationalfun" representing the derivative of the original rational function.

**See Also**

[deriv.polynomial](#), [deriv](#)

### Examples

```
# (x + 1) / (x^2 + x + 1)
r <- rationalfun(c(1, 1), c(1, 1, 1))
deriv(r)
```

---

int2fun

*Convert a call to a function*

---

### Description

Convert a function call to a function in R. In this package, the function is typically used to convert the result of `integral.rationalfun()` to a function with one argument.

### Usage

```
int2fun(expr)
```

### Arguments

`expr` a function call, typically returned by `integral.rationalfun()`.

### Value

A function with one argument which could be a real or complex vector.

### See Also

[integral.polynomial](#)

### Examples

```
x <- rationalfun(c(-6, -1, -8, 15, -1, 8, -9, 2),
  c(8, 12, 16, 4, 4))
int <- integral(x)
fun <- int2fun(int)
fun(c(0, 1))
```

---

integral.rationalfun *Integrate a rational function*

---

### Description

Calculate the integral of a rational function. See "Details".

### Usage

```
## S3 method for class 'rationalfun'  
integral(expr, ...)
```

### Arguments

expr	an object of class "rationalfun"
...	not used in this function

### Details

The returned value is a function call with argument named "x". That is, the integral is an expression in R with an explicit form, which could be evaluated directly by calling `eval()`, or indirectly using the `int2fun()` function.

The algorithm is based on the Hermite-Ostrogradski formula which is discussed in the reference. See the article for more details.

### Value

A function call representing the explicit form of the integral.

### References

T. N. Subramaniam, and Donald E. G. Malm, How to Integrate Rational Functions, *The American Mathematical Monthly*, Vol. 99, No.8 (1992), 762-772.

### See Also

[integral.polynomial](#)

### Examples

```
# (x + 1) / (x^2 + x + 1)  
r <- rationalfun(c(1, 1), c(1, 1, 1))  
expr <- integral(r)  
# Evaluate the call directly  
eval(expr, list(x = 2))  
# Use int2fun()  
f <- int2fun(expr)  
f(2)
```

---

Ops.rationalfun      *Operators for rational functions*

---

**Description**

Basic arithmetic operators for rational functions.

**Usage**

```
## S3 method for class 'rationalfun'
Ops(e1, e2)
```

**Arguments**

e1                    an object of class "rationalfun"  
 e2                    for "^", a positive integer; in other cases, an object of class "rationalfun"

**Value**

A new object of "rationalfun" class.

**Examples**

```
r1 <- rationalfun(c(1, 2), c(1, 2, 1))
r2 <- rationalfun(c(1, 1), c(1, -2, 1))
r1 + r2
r1 * r2
r1^2
```

---

predict.rationalfun      *Evaluate a rational function*

---

**Description**

Evaluate a rational function at a real or complex vector.

**Usage**

```
## S3 method for class 'rationalfun'
predict(object, newdata, ...)
```

**Arguments**

object                an object of class "rationalfun"  
 newdata              a vector at which evaluation is requested.  
 ...                    not used in this function Both real and complex vectors are accepted.

**Value**

A vector of evaluated results.

**See Also**

[predict.polynomial](#)

**Examples**

```
r <- rationalfun(c(1, 1), c(3, 2, 1))
predict(r, 1:10)
```

---

`print.rationalfun`      *Print a rational function*

---

**Description**

Print a rational function in a fraction form.

**Usage**

```
## S3 method for class 'rationalfun'
print(x, ...)
```

**Arguments**

<code>x</code>	an object of class "rationalfun"
<code>...</code>	not used in this function

**Value**

Invisible, the object itself.

**See Also**

[print.polynomial](#)

**Examples**

```
r <- rationalfun(c(1, 1), c(3, 2, 1))
print(r)
```

---

rationalfun	<i>Construction of rational functions</i>
-------------	---

---

**Description**

Construction of rational functions.

**Usage**

```
rationalfun(number = c(0, 1), denom = c(1, 1, 1))

rfun(number = c(0, 1), denom = c(1, 1, 1))

rationalfun.poly(number = polynomial(c(0, 1)), denom = polynomial(c(1,
  1, 1)))

rfun.poly(number = polynomial(c(0, 1)), denom = polynomial(c(1,
  1, 1)))
```

**Arguments**

number	in <code>rationalfun()</code> , the coefficient vector of the numerator; in <code>rationalfun.poly()</code> , an object of class "polynom" in <b>polynom</b> package representing the numerator
denom	similar to <code>number</code> , but for the denominator

**Details**

A rational function object could be constructed either by calling `rationalfun()` or by calling `rationalfun.poly()`.

`rationalfun()` constructs a rational function from the coefficient vectors of the numerator and the denominator. For example, consider a rational function  $R(x) = P(x)/Q(x)$  where

$$P(x) = p_1 + p_2x + p_3x^2 + \dots + p_kx^{k-1}$$

and

$$Q(x) = q_1 + q_2x + q_3x^2 + \dots + q_mx^{m-1}$$

, you may call `rationalfun(p[1:k], q[1:m])` to build the object.

For `rationalfun.poly()`, it receives two objects of class "polynomial" from the **polynom** package, representing the polynomials of the numerator and the denominator respectively. Use this function if you already have objects of "polynomial" class, typically by calling `polynomial()`, `poly.calc()` or `poly.orth()`.

`rfun()` and `rfun.poly()` are aliases of `rationalfun()` and `rationalfun.poly()` in order to type fewer letters.

The value returned by `rationalfun()` and `rationalfun.poly()` is an object of class "rationalfun". You can coerce the object to a function, by calling `as.function.rationalfun()`, or to a character string, by calling `as.character.rationalfun()`.



Objects of "rationalfun" class support basic operators including "+", "-", "\*", "/" and "^". To evaluate a rational function at a given vector, use `predict.rationalfun()`. To compute the derivative and integral in **explicit** form, call `deriv.rationalfun()` and `integral.rationalfun()` respectively.

### Value

An object of class "rationalfun".

### See Also

[polynomial](#), [poly.calc](#), [poly.orth](#)

### Examples

```
# (x + 1) / (x^2 + 2 * x + 3)
r1 <- rationalfun(c(1, 1), c(3, 2, 1))
print(r1)
# Construct from objects of 'polynomial' class
if (require(polynom)) {
  p1 <- poly.calc(c(1, 2))
  p2 <- polynomial(rep(1, 5))
  r2 <- rfun.poly(p1, p2)
  print(r2)
}
```

---

simplify

*Simplify a rational function*

---

### Description

Simplify a rational function by dropping terms whose coefficients are close to zero, and then reducing it to an irreducible form.

### Usage

```
simplify(x, ...)
```

### Arguments

x                    an object of class "rationalfun"  
 ...                   currently not used in this function

### Value

A new object of class "rationalfun" representing the simplified rational function.

**Examples**

```
# (x + 1) / (x^2 + 2 * x + 1) ==> 1 / (x + 1)
r <- rationalfun(c(1, 1), c(1, 2, 1))
simplify(r)
```

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