Package ‘FindAllRoots’
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Type Package
Title Find all root(s) of the equation and Find root(s) of the equation by dichotomy
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Description Find all root(s) of the equation, including complex roots; Find root(s) of the equation by dichotomy. Besides, in dichotomy, more than one interval can be given at a time.
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FindAllRoots-package Find all root(s) of the equation and Find root(s) of the equation by dichotomy

Description

Find all root(s) of the equation, including complex roots; Find root(s) of the equation by dichotomy

Details
allroots

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Author(s)
Bingpei Wu & Jiajun He & Sijie Chen & Yangyang Liu
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References
a passage about finding all roots, whose author is Dequan Shang
a passage about finding root(s) of equation, whose author is Yong Ling

Examples
a=c(2,-1,-13,-1,-5)
b=c(4:0)
x1=c(1:10)
x2=c(2:11)
allroots(a,b)
dichotomy(x1,x2,a,b)

allroots
Find all roots of the equation, including complex roots.

Description
find all roots of the equation, including complex roots

Usage
allroots(a, b)

Arguments
a vector of coefficients of the equation
b vector of exponention of the equation, One one corresponding with a mentioned above

Details
a should be one one corresponding with b, or there might lead to wrong results
dichotomy

**Value**

all roots of the equation, including complex roots. Besides, the inaccuracy error of the roots is also given.

**Author(s)**

Bingpei Wu

**References**

a passage about finding all roots, whose author is Dequan Shang

**Examples**

```r
##-- Should be DIRECTLY executable !! ----
##--  Define data, use random,
##-- or do help(data=index) for the standard data sets.

a=c(2,-1,-13,-1,-5)
b=c(4:0)
allroots(a,b)

## The function is currently defined as
## function (a, b)
##{
##   a1 = a
##   b1 = b
##   n = length(b) - 1
##   a = a/a[1]
##   b = matrix(0, ncol = n, nrow = n)
##   for (i in 1:(n - 1)) b[i, i + 1] = 1
##   for (i in 1:n) b[n, i] = -a[n + 2 - i]
##   c = eigen(b)
##   print(c$values)
##   print("inaccuracy error")
##   print(f(c$values, a1, b1))
## }
```

---

dichotomy  

Find root(s) of the equation by dichotomy

**Description**

Find root(s) of the equation by dichotomy. Besides, in dichotomy, more than one interval can be given at a time.

**Usage**

dichotomy(x1, x2, a, b, pert = 10^(-5), n = 1000, s = 0.1)
Arguments

- \( x_1 \): vector of left end point of interval(s)
- \( x_2 \): vector of right end point of interval(s)
- \( a \): vector of coefficients of the equation
- \( b \): vector of exponention of the equation, one corresponding with a mentioned above
- \( \text{pert} \): precision of root(s)
- \( n \): the algorithm runs \( n \) times at most in one interval and NA will be returned
- \( s \): assuming \( x_0 \) is midpoint of interval \([a,b]\). If \( f(x_0) \cdot f(a) > 0 \) and \( f(x_0) \cdot f(b) > 0 \), \( b \) will minus \( s \).

Details

If you want to find root(s) of the equation in \([a_1,b_1],[a_2,b_2],\ldots,[a_n,b_n]\), \( x_1 \) should be \( c(a_1,a_2,\ldots,a_n) \) and \( x_2 \) should be \( c(b_1,b_2,\ldots,b_n) \). If there is no root in \([a_1,b_1]\), but there is a root in \([\min(a_1,b_1-n\cdot s),\max(a_1,b_1-n\cdot s)]\), the algorithm can still find the root. So the returned root may not in \([a_n,b_n]\) that you give but must be in \([\min(a_1,b_1-n\cdot s),\max(a_1,b_1-n\cdot s)]\).

Value

the root(s) of the equation that the difference between returned root(s) and the real root(s) of the equation is less than 10e-6

Author(s)

Bingpei Wu

References

a passage about finding root(s) of equation, whose author is Yong Ling

Examples

```r
### Should be DIRECTLY executable !! ----
### => Define data, use random,  
### or do help(data=index) for the standard data sets.
# a=c(2,-1,-13,-1,-5)  
# b=c(4:0)  
# x1=c(1:10)  
# x2=c(2:11)  
# dichotomy(x1,x2,a,b)  

# The function is currently defined as  
function (x1, x2, a, b, pert = 10^(-5), n = 1000, s = 0.1) {  
ex0 = rep(NA, length(x1))  
for (i in 1:length(x1)) {  
  if (f(x1[i], a, b) == 0) {  
    ex0[i] = (a[i] + b[i]) / 2  
  }  
  else {  
    f0 = f(x0[i], a, b)  
    x0[i] = x0[i] + pert  
    while (abs(f0 * f(x0[i], a, b)) > 10^(-6)) {  
      x0[i] = x0[i] + pert  
    }  
  }  
}  
return(ex0)  
}```
```r
x0[i] = x1[i]
if (f(x2[i], a, b) == 0)
x0[i] = x2[i]
if (f(x[i], a, b) != 0 & f(x2[i], a, b) != 0) {
  x0[i] = (x1[i] + x2[i])/2
  k = 1
  while ((abs(f(x0[i], a, b)) >= pert) & (k < n)) {
    if (f(x0[i], a, b) == 0)
      break
    if (f(x1[i], a, b) * f(x0[i], a, b) < 0)
      x2[i] = x0[i]
    if (f(x2[i], a, b) * f(x0[i], a, b) < 0)
      x1[i] = x0[i]
    if (x1[i] != x0[i] & x2[i] != x0[i])
      x2[i] = x2[i] - s
      x0[i] = (x1[i] + x2[i])/2
      k = k + 1
    if (k == 1000)
      x0[i] = NA
  }
}
x0
```

---

**f**

*function returning one function value, or a vector of function values.*

---

**Description**

function returning one function value, or a vector of function values.

**Usage**

```r
f(x, a, b)
```

**Arguments**

- **x**: either one value or a vector containing the x-value(s)
- **a**: vector of coefficients of the equation
- **b**: vector of exponention of the equation, one corresponding with a mentioned above

**Details**

the function f that estimates the function values will be called as f(x, ...). If x is a vector, then the first argument passed to f should also be a vector.
Value

the value(s) of the function equation, one function value, or a vector of function values.

Author(s)

Bingpei Wu

Examples

```r
## Should be DIRECTLY executable !! ----
## Define data, use random,
## or do   help(data=index) for the standard data sets.
## a = c(2, -1, -13, -1, -5)
b = c(4:0)
x = c(1:3)
f(x, a, b)

## The function is currently defined as
## function (x, a, b)
## {
##   z = 0
##   for (i in 1:length(b)) z = z + a[i] * x^(b[i])
##   z
## }
```
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