Running funconstrain tests in package optimx

John C. Nash (profjcnash *at* gmail.com)

2024-04-08

Abstract

The `funconstrain` package (https://github.com/jlmelville/funconstrain) provides R users with a convenient tool to access the test functions of Moré, Garbow, and Hillstrom (1981). This vignette article describes a program to apply these test functions to solvers in the `optimx` package (Nash and Varadhan (2011)).

Background

Numerical optimization of functions of several, namely `n`, parameters is an important computational task. R (R Development Core Team (2008)) is a major platform for scientific and statistical calculations and has provided tools for numerical optimization and nonlinear least squares since its inception. These have been extended via a number of packages. In particular, the author has been heavily involved in this effort, and in collaboration with others has provided the packate `optimx` which wraps a number of solvers to allow their invocation by a common calling syntax. Note that *optimization* in R generally means *function minimization*, possibly with bounds (or box) constraints on the function parameters.

It is extremely helpful to users to have examples and tests of function minimization. In many situations it is extremely easy to insert an error into code, so easy-to-apply tests allow for the discovery of such errors. There are a number of collections of test functions with many overlaps and minor differences. A well-established and well-documented set of such functions are those of Moré, Garbow, and Hillstrom (1981). These have been translated into R by James Melville in the R package `funconstrain` (https://github.com/jlmelville/funconstrain). While initially these provided the function and its gradient given a set of suitable input parameters, the present author added code to compute the Hessian for each test function. This allows Newton-like solvers to be applied. `funconstrain` also provides suggested initial parameter vectors for each of the 35 test functions. However, where there are multiple input possibilities, just one is provided, for example when the test function has a variable number of parameters.

What is then missing is the link between `funconstrain` and the tools in `optimx`, which this article aims to provide.

Function fufn()

Most of the test functions in (**More1981TU?**) are sums of squares of nonlinear functions. While `n` is the number of parameters, we may have a different number of functions squared in the summation. Call this `m`. This may be altered to give different variations of a given function, so `m` must be provided.

Many of the solvers in `optimx` are capable of handling bounds constraints on the `n` parameters. That is parameter `i` must satisfy

```
lower[i] <= prm[i] <= upper[i]
```

where `prm` is the parameter vector and `lower` and `upper` are vectors of numbers providing lower and upper bounds. Methods in `optimx` that can handle masks are listed in the character vector `bdmeth` returned by the function `optimx::ctrldefault(n)`. Note that a number of parameters `n` must nominally be provided to `ctrldefault()` but generally `n` can be specified as 2 to get the default settings for ‘optimx. At time of writing

```
bdmeth <- c("L-BFGS-B", "nlminb", "lbfgsb3c", "Rcgmin", "Rtnmin", "nvm",
"Rvmmin", "bobyqa", "nmkb", "hjkb", "hjn", "snewtonm", "ncg",
"slsqp", "tnewt", "nlnm", "snewtm", "spg")
```

If the upper and lower bound for a parameter are equal, we can say the parameter is **fixed** or **masked**. This may seem to be a silly option, since it essentially reduces the dimensionality of the problem. However, there are many situations where we have evidence that a parameter takes a particular (fixed) value, but know that we may wish to allow optimization over that parameter in later investigations. Masks allow us to avoid having to rewrite the function, gradient and Hessian code. However, only a few optimization solvers handle masks. The function `optimx::ctrldefault()` returns a value `maskmeth` with a list of solvers that do handle the situation where lower and upper bounds coincide. At the time of writing this is specified as

```
maskmeth <- c("Rcgmin", "nvm", "hjn", "ncg", "snewtonm", "nlminb", "L-BFGS-B")
```

With the above in mind, the function `fufn()` was written to access the test functions of `funconstrain`.

The fufn.R code

```
fufn <- function(n=NULL, fnum=NULL){
  # return list with tfn=function, tgr=gradient given fn number and n
  if (is.null(fnum)) stop("ffn needs a function number fnum")
  if ((fnum < 1) || (fnum > 35)) stop("fnum must be in [1, 35]")
#  cat("entering ffn, fnum=",fnum,"\n")
  # select function
  funnam <- c("rosen", "freud_roth", "powell_bs", "brown_bs", "beale",
              "jenn_samp", "helical", "bard", "gauss", "meyer", "gulf",
              "box_3d", "powell_s", "wood", "kow_osb", "brown_den",
              "osborne_1", "biggs_exp6", "osborne_2", "watson", "ex_rosen",
              "ex_powell", "penalty_1", "penalty_2", "var_dim", "trigon",
              "brown_al", "disc_bv", "disc_ie", "broyden_tri", "broyden_band",
              "linfun_fr", "linfun_r1", "linfun_r1z", "chebyquad")
#  print(str(funnam))
  fname <- funnam[as.integer(fnum)]
#  cat("fname:", fname,"\n")
  while (fnum %in% 1:35) {
    ameth <- optimx::ctrldefault(2)$bdmeth # Choose only bounded methods
    ameth <- ameth[ameth != "lbfgsb3c"] ## ?? Temporarily remove lbfgsb3c
    ameth <- c(ameth, "L-BFGS-B")
    # ?? may want to test allmeth to check that inappropriate methods are captured
    #    cat("in while, fnum=", fnum); tmp <- readline("cont.")
    mm <- 0 # in case m value needed
  if (fnum == 1) {
     n <- 2 # fixed
     mm <- 2
     tt <- rosen()
     if (is.function(tt$x0)) {
       xx0<-tt$x0(n)
     }
     else xx0 <- tt$x0
     lo <- rep((min(xx0)-0.1), n)
     up <- rep((max(xx0)+0.1), n)
     break }

  if (fnum == 2) {
     n <- 2 # fixed
```

```
    mm <- 2
    tt <- freud_roth()
    if (is.function(tt$x0)) {
      xx0<-tt$x0(n)
    }
    else xx0 <- tt$x0
    lo <- rep((min(xx0)-0.1), n)
    up <- rep((max(xx0)+0.1), n)
    break }

  if (fnum == 3) {
    n <- 2 # fixed
    mm <- 2
    tt <- powell_bs()
    if (is.function(tt$x0)) {
      xx0<-tt$x0(n)
    }
    else xx0 <- tt$x0
    lo <- rep((min(xx0)-0.1), n)
    up <- rep((max(xx0)+0.1), n)
    break }

  if (fnum == 4) {
    n <- 2 # fixed
    mm <- 3
    tt <- brown_bs()
    if (is.function(tt$x0)) {
      xx0<-tt$x0(n)
    }
    else xx0 <- tt$x0
## BAD -- reset 20240323
#     lo <- rep((min(xx0)-0.1), n)
#     up <- rep((max(xx0)+0.1), n)
    lo <- -1e20
    up <- -lo
    break }

  if (fnum == 5) {
    n <- 2 # fixed
    mm <- 3
    tt <- beale()
    if (is.function(tt$x0)) {
      xx0<-tt$x0(n)
    }
    else xx0 <- tt$x0
    lo <- rep((min(xx0)-0.1), n)
    up <- rep((max(xx0)+0.1), n)
    break }

  if (fnum == 6) {
    n <- 2 # fixed
    mm <- 10
    tt <- jenn_samp()
```

```
    if (is.function(tt$x0)) {
      xx0<-tt$x0(n)
    }
    else xx0 <- tt$x0
    lo <- rep((min(xx0)-0.1), n)
    up <- rep((max(xx0)+0.1), n)
    break }

  if (fnum == 7) {
    n <- 3 # fixed
    tt <- helical()
    if (is.function(tt$x0)) {
      xx0<-tt$x0(n)
    }
    else xx0 <- tt$x0
    lo <- rep((min(xx0)-0.1), n)
    up <- rep((max(xx0)+0.1), n)
    break }

  if (fnum == 8) {
    n <- 3 # fixed
    mm <- 15
    tt <- bard()
    if (is.function(tt$x0)) {
      xx0<-tt$x0(n)
    }
    else xx0 <- tt$x0
    lo <- rep((min(xx0)-0.1), n)
    up <- rep((max(xx0)+0.1), n)
    break }

  if (fnum == 9) {
    n <- 3 # fixed
    mm <- 15
    tt <- gauss()
    if (is.function(tt$x0)) {
      xx0<-tt$x0(n)
    }
    else xx0 <- tt$x0
    lo <- rep((min(xx0)-0.1), n)
    up <- rep((max(xx0)+0.1), n)
    break }

  if (fnum == 10) {
    n <- 3 # fixed
    m <- 16 # ?? how to return
    tt <- meyer()
    if (is.function(tt$x0)) {
      xx0<-tt$x0(n)
    }
    else xx0 <- tt$x0
    lo <- rep((min(xx0)-0.1), n)
    up <- rep((max(xx0)+0.1), n)
```

```
   break }

if (fnum == 11) {
   n <- 3
   mm <- 99
   tt <- gulf()
   if (is.function(tt$x0)) {
     xx0<-tt$x0(n)
   }
   else xx0 <- tt$x0
   lo <- rep((min(xx0)-0.1), n)
   up <- rep((max(xx0)+0.1), n)
   break }

if (fnum == 12) {
   n <- 3
   mm <- 20
   tt <- box_3d()
   if (is.function(tt$x0)) {
     xx0<-tt$x0(n)
   }
   else xx0 <- tt$x0
   lo <- rep((min(xx0)-0.1), n)
   up <- rep((max(xx0)+0.1), n)
   break }

if (fnum == 13) {
   n <- 4
   tt <- powell_s()
   if (is.function(tt$x0)) {
     xx0<-tt$x0(n)
   }
   else xx0 <- tt$x0
   lo <- rep((min(xx0)-0.1), n)
   up <- rep((max(xx0)+0.1), n)
   break }

if (fnum == 14) {
   n <- 4
   tt <- wood()
   if (is.function(tt$x0)) {
     xx0<-tt$x0(n)
   }
   else xx0 <- tt$x0
   lo <- rep((min(xx0)-0.1), n)
   up <- rep((max(xx0)+0.1), n)
   break }

if (fnum == 15) {
   mm <- 11
   n <- 4
   tt <- kow_osb()
   if (is.function(tt$x0)) {
```

```
      xx0<-tt$x0(n)
    }
    else xx0 <- tt$x0
    lo <- rep((min(xx0)-0.1), n)
    up <- rep((max(xx0)+0.1), n)
    break }

if (fnum == 16) {
    mm <- 20
    n <- 4
    tt <- brown_den()
    if (is.function(tt$x0)) {
      xx0<-tt$x0(n)
    }
    else xx0 <- tt$x0
    lo <- rep((min(xx0)-0.1), n)
    up <- rep((max(xx0)+0.1), n)
    break }

if (fnum == 17) {
    mm <- 33
    n <- 5
    tt <- osborne_1()
    ameth<-ameth[-which(ameth=="L-BFGS-B")] # remove L-BFGS-B from this case
    if (is.function(tt$x0)) {
      xx0<-tt$x0(n)
    }
    else xx0 <- tt$x0
    lo <- rep((min(xx0)-0.1), n)
    lo[4] <- 0
    lo[5] <- 0
    up <- rep((max(xx0)+0.1), n)
    break }

if (fnum == 18) {
    mm <- 20
    n <- 6
    tt <- biggs_exp6()
    if (is.function(tt$x0)) {
      xx0<-tt$x0(n)
    }
    else xx0 <- tt$x0
    lo <- rep((min(xx0)-0.1), n)
    up <- rep((max(xx0)+0.1), n)
    break }

if (fnum == 19) {
    mm <- 65
    n <- 11
    tt <- osborne_2()
    if (is.function(tt$x0)) {
      xx0<-tt$x0(n)
    }
```

```
    else xx0 <- tt$x0
    lo <- rep((min(xx0)-0.1), n)
    up <- rep((max(xx0)+0.1), n)
    break }

  if (fnum == 20) {
    n <-8
    mm <- 31
    tt <- watson()
    if (is.function(tt$x0)) {
      xx0<-tt$x0(n)
    }
    else xx0 <- tt$x0
    lo <- rep((min(xx0)-0.1), n)
    up <- rep((max(xx0)+0.1), n)
    break }

  if (fnum == 21) {
    n <- 10
    tt <- ex_rosen()
    if (is.function(tt$x0)) {
      xx0<-tt$x0(n)
    }
    else xx0 <- tt$x0
    lo <- rep((min(xx0)-0.1), n)
    up <- rep((max(xx0)+0.1), n)
    break }

  if (fnum == 22) {
    n <- 20
    tt <- ex_powell()
    if (is.function(tt$x0)) {
      xx0<-tt$x0(n)
    }
    else xx0 <- tt$x0
    lo <- rep((min(xx0)-0.1), n)
    up <- rep((max(xx0)+0.1), n)
    break }

  if (fnum == 23) {
    n <- 10
    mm <- n + 1
    tt <- penalty_1()
    if (is.function(tt$x0)) {
      xx0<-tt$x0(n)
    }
    else xx0 <- tt$x0
    lo <- rep((min(xx0)-0.1), n)
    up <- rep((max(xx0)+0.1), n)
    break }

  if (fnum == 24) {
    n <- 10
```

```
    mm <- n + 1
    tt <- penalty_2()
    if (is.function(tt$x0)) {
      xx0<-tt$x0(n)
    }
    else xx0 <- tt$x0
    lo <- rep((min(xx0)-0.1), n)
    up <- rep((max(xx0)+0.1), n)
    break }

  if (fnum == 25) {
    n <- 6
    mm <- n + 2
    tt <- var_dim()
    if (is.function(tt$x0)) {
      xx0<-tt$x0(n)
    }
    else xx0 <- tt$x0
    lo <- rep((min(xx0)-0.1), n)
    up <- rep((max(xx0)+0.1), n)
    break }

  if (fnum == 26) {
    n <- 8
    tt <- trigon()
    if (is.function(tt$x0)) {
      xx0<-tt$x0(n)
    }
    else xx0 <- tt$x0
    lo <- rep((min(xx0)-0.1), n)
    up <- rep((max(xx0)+0.1), n)
    break }

  if (fnum == 27) {
    n <- 8
    mm <- n
    tt <- brown_al()
    if (is.function(tt$x0)) {
      xx0<-tt$x0(n)
    }
    else xx0 <- tt$x0
    lo <- rep((min(xx0)-0.1), n)
    up <- rep((max(xx0)+0.1), n)
    break }

  if (fnum == 28) {
    n <- 6
    mm <- n
    tt <- disc_bv()
    if (is.function(tt$x0)) {
      xx0<-tt$x0(n)
    }
    else xx0 <- tt$x0
```

```
    lo <- rep((min(xx0)-0.1), n)
    up <- rep((max(xx0)+0.1), n)
    break }

  if (fnum == 29) {
    n <- 8
    mm <- n
    tt <- disc_ie()
    if (is.function(tt$x0)) {
      xx0<-tt$x0(n)
    }
    else xx0 <- tt$x0
    lo <- rep((min(xx0)-0.1), n)
    up <- rep((max(xx0)+0.1), n)
    break }

  if (fnum == 30) {
    n <- 8
    mm <- n
    tt <- broyden_tri()
    if (is.function(tt$x0)) {
      xx0<-tt$x0(n)
    }
    else xx0 <- tt$x0
    lo <- rep((min(xx0)-0.1), n)
    up <- rep((max(xx0)+0.1), n)
    break }

  if (fnum == 31) {
    n <- 8
    mm <- n
    tt <- broyden_band()
    if (is.function(tt$x0)) {
      xx0<-tt$x0(n)
    }
    else xx0 <- tt$x0
    lo <- rep((min(xx0)-0.1), n)
    up <- rep((max(xx0)+0.1), n)
    break }

  if (fnum == 32) {
    mm <- 10
    n <- 8
    tt <- linfun_fr()
    if (is.function(tt$x0)) {
      xx0<-tt$x0(n)
    }
    else xx0 <- tt$x0
    lo <- rep((min(xx0)-0.1), n)
    up <- rep((max(xx0)+0.1), n)
    break }

  if (fnum == 33) {
```

```
    mm <- 10
    n <- 8
    tt <- linfun_r1()
    if (is.function(tt$x0)) {
      xx0<-tt$x0(n)
    }
    else xx0 <- tt$x0
    lo <- rep((min(xx0)-0.1), n)
    up <- rep((max(xx0)+0.1), n)
    break }

  if (fnum == 34) {
    mm <- 10
    n <- 8
    tt <- linfun_r1z()
    if (is.function(tt$x0)) {
      xx0<-tt$x0(n)
    }
    else xx0 <- tt$x0
    lo <- rep((min(xx0)-0.1), n)
    up <- rep((max(xx0)+0.1), n)
    break }

  if (fnum == 35) {
     n <- 8
     m <- n
     tt <- chebyquad()
     if (is.function(tt$x0)) {
       xx0<-tt$x0(n)
     }
     else xx0 <- tt$x0
     lo <- rep((min(xx0)-0.1), n)
     up <- rep((max(xx0)+0.1), n)
     break }
  }
# NOTE: bounds are experimental only
  mask <- rep(1L, n) # masks set to "free" (not masked)
  val <- list(npar = n, fffn=tt$fn, ffgr=tt$gr, x0=xx0, lo=lo, up=up,
              mask=mask, fname=fname, ameth=ameth)
#  cat("val:"); print(val); tmp<-readline('exit ffn')
  val
} # end fufn
```

Calling fufn()

While we can write our own driver for `fufn()`, I wanted to make the task extremely easy. Thus the script `fufnrun.R` is provided. This is set up to use a simple text file to specify which test functions are to be applied to which solvers. Moreover, a "sink" function name can be specified to save the text output of the run.

Test specification file RFO.txt

Let us consider an example.

```
testsink230324A.txt
1, 6:8, 35
c("L-BFGS-B",  "lbfgsb3c", "lbfgs", "lbfgsb3")
FALSE
```

The lines of the above file provide the following information:

- the first line is the name of the text file to use to save the output
- line 2 says that test functions 1, 6, 7, 8, and 35 are to be used. Note that we can use the colon ":" when giving a contiguous range of function numbers. These numbers – by referring back to the vector `funnam` at the top of function `fufn()` – specify functions "rosen", "jenn-samp", "helical", "bard" and "chebyquad". Using the function numbers. Appendix A lists the numbers and corresponding names.
- line 3 gives an R character vector of the solver methods to be applied.

‘ line 4 is TRUE if the experimental bounds constraints are to be applied.

A driver program for fufn()

The following driver program will run the tests specified by RFO.txt:

```
# fufnrun.R -- J C Nash 2024-4-8
## ?? fixing kkt
# Assume fufn.R has been loaded
source("./fufn.R")
sfname <- readline("Sink name=")
```

```
## Sink name=
```

```
# source("~/optimr.R")
sink(sfname, split=TRUE)
```

```
## Warning in file(file, if (append) "a" else "w"): file("") only supports open =
## "w+" and open = "w+b": using the former
```

```
library(funconstrain)  # get the functions
library(optimx)
tmp <- readline("begin")
```

```
## begin
```

```
# iprob <- as.numeric(readline("Prob #"))
iprob <- 1
while (iprob %in% 1:35){
tfun <- fufn(fnum=iprob)
# print(tfun)
cat("Problem:", tfun$fname,"\n")
x0 <- tfun$x0
lo <- tfun$lo
up <- tfun$up
tfn <- tfun$fffn
attr(tfn, "fname") <- tfun$fname
tgr <- tfun$ffgr
the <- tfun$ffhe
ameth<-unlist(tfun$ameth)
# ameth<-"ALL"
# ?? masking?
cat("about to call opm\n")
```

```r
nx0<-length(x0)
t21 <-opm(x0, tfn, tgr, hess=the, lower=lo, upper=up, method=ameth, contro=list(trace=0))
print(summary(t21, order=value, par.select=1:min(nx0,5)))
cat("END :", tfun$fname,"\n\n")

# iprob <- as.numeric(readline("Prob #")) # Must have as.numeric
 tmp <- readline("next")
iprob <- iprob + 1
}
```

```
## Problem: rosen
## about to call opm

## Warning in opm(x0, tfn, tgr, hess = the, lower = lo, upper = up, method =
## ameth, : Duplicate methods requested by user removed

## Warning in opm(x0, tfn, tgr, hess = the, lower = lo, upper = up, method =
## ameth, : 'snewtonm' removed from 'method' -- no hess()

## Warning in opm(x0, tfn, tgr, hess = the, lower = lo, upper = up, method =
## ameth, : 'snewtm' removed from 'method' -- no hess()

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
```

```
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

##               p1 s1     p2 s2      value fevals gevals hevals conv  kkt1  kkt2
## nvm       1.0000    1.0000    0.0000e+00     53     44      0    2  TRUE  TRUE
## Rvmmin    1.0000    1.0000    0.0000e+00     53     44      0    2  TRUE  TRUE
## nlminb    1.0000    1.0000    1.9371e-27     46     35      0    0  TRUE  TRUE
## slsqp     1.0000    1.0000    6.0308e-22     58     57      0    0  TRUE  TRUE
## Rcgmin    1.0000    1.0000    4.6641e-21    130     68      0    0  TRUE  TRUE
## tnewt     1.0000    1.0000    1.1565e-20     65     64      0    0  TRUE  TRUE
## ncg       1.0000    1.0000    1.4877e-20    153     80      0    0  TRUE  TRUE
## nlnm      1.0000    1.0000    2.9346e-14    217      0      0    0  TRUE  TRUE
## L-BFGS-B  1.0000    1.0000    4.3670e-14     19     19      0    0  TRUE  TRUE
## lbfgsb3   1.0000    1.0000    4.3670e-14     19     19      0    0  TRUE  TRUE
## bobyqa    1.0000    1.0000    2.5761e-13    571      0      0    0  TRUE  TRUE
## hjn       1.0000    1.0000    2.5544e-10    700      0      0    0  TRUE  TRUE
## spg       1.0000    1.0001    1.3287e-09     38     20      0    0  TRUE  TRUE
## hjkb      1.0001    1.0001    5.5989e-09    525      0      0    0  TRUE  TRUE
## nmkb      1.0002    1.0005    5.5406e-07    250      0      0    0 FALSE  TRUE
## Rtnmin   -1.0441    1.1000  U 4.1881e+00    130    130      0    0 FALSE FALSE
##          xtime
## nvm      0.003
## Rvmmin   0.004
## nlminb   0.001
## slsqp    0.003
## Rcgmin   0.000
## tnewt    0.002
## ncg      0.002
## nlnm     0.002
## L-BFGS-B 0.000
## lbfgsb3  0.003
## bobyqa   0.053
## hjn      0.005
## spg      0.006
## hjkb     0.005
## nmkb     0.012
## Rtnmin   0.004
## END : rosen
##
## next
## Problem: freud_roth
## about to call opm

## Warning in opm(x0, tfn, tgr, hess = the, lower = lo, upper = up, method =
```

```
## ameth, : Duplicate methods requested by user removed
## Warning in opm(x0, tfn, tgr, hess = the, lower = lo, upper = up, method =
## ameth, : 'snewtonm' removed from 'method' -- no hess()
## Warning in opm(x0, tfn, tgr, hess = the, lower = lo, upper = up, method =
## ameth, : 'snewtm' removed from 'method' -- no hess()
## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing
```

```
##           p1 s1      p2 s2  value fevals gevals hevals conv  kkt1 kkt2 xtime
## nvm      0.6  U -1.4541    98.312     19      8      0    0 FALSE TRUE 0.001
## Rvmmin   0.6  U -1.4541    98.312     19      8      0    0 FALSE TRUE 0.001
## bobyqa   0.6  U -1.4541    98.312     45      0      0    0 FALSE TRUE 0.001
## slsqp    0.6  U -1.4541    98.312     12     11      0    0 FALSE TRUE 0.001
## Rcgmin   0.6  U -1.4541    98.312     14     10      0    0 FALSE TRUE 0.000
## ncg      0.6  U -1.4541    98.312     14      8      0    0 FALSE TRUE 0.001
## spg      0.6  U -1.4541    98.312     34     15      0    0 FALSE TRUE 0.002
## Rtnmin   0.6  U -1.4541    98.312     22     22      0    0 FALSE TRUE 0.002
## tnewt    0.6  U -1.4541    98.312     18     17      0    0 FALSE TRUE 0.002
## L-BFGS-B 0.6  U -1.4541    98.312     13     13      0    0 FALSE TRUE 0.000
## nlminb   0.6  U -1.4541    98.312      9      8      0    0 FALSE TRUE 0.000
## lbfgsb3  0.6  U -1.4541    98.312     15     15      0    0 FALSE TRUE 0.001
## hjn      0.6  U -1.4541    98.312    119      0      0    0 FALSE TRUE 0.000
## nlnm     0.6  U -1.4541    98.312     79      0      0    0 FALSE TRUE 0.001
## hjkb     0.6  U -1.4541    98.312    144      0      0    0 FALSE TRUE 0.001
## nmkb     0.6    -1.4542    98.312     77      0      0    0 FALSE TRUE 0.004
## END : freud_roth
##
## next
## Problem: powell_bs
## about to call opm

## Warning in opm(x0, tfn, tgr, hess = the, lower = lo, upper = up, method =
## ameth, : Duplicate methods requested by user removed

## Warning in opm(x0, tfn, tgr, hess = the, lower = lo, upper = up, method =
## ameth, : 'snewtonm' removed from 'method' -- no hess()

## Warning in opm(x0, tfn, tgr, hess = the, lower = lo, upper = up, method =
## ameth, : 'snewtm' removed from 'method' -- no hess()

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing
```

```
## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing
##                  p1 s1      p2 s2   value fevals gevals hevals conv  kkt1  kkt2
## nlminb   9.0912e-05    1.10000  U 0.11068     18      6      0    0 FALSE FALSE
## Rcgmin   9.0912e-05    1.10000  U 0.11068     19      6      0    0 FALSE FALSE
## Rtnmin   9.0912e-05    1.10000  U 0.11068      9      9      0    0 FALSE FALSE
## nvm      9.0912e-05    1.10000  U 0.11068     21      8      0    0 FALSE FALSE
## Rvmmin   9.0912e-05    1.10000  U 0.11068     21      8      0    0 FALSE FALSE
## ncg      9.0912e-05    1.10000  U 0.11068     21      5      0    0 FALSE FALSE
## slsqp    9.0912e-05    1.10000  U 0.11068     13     12      0    0 FALSE FALSE
## tnewt    9.0912e-05    1.10000  U 0.11068     17     16      0    0 FALSE FALSE
## spg      9.0912e-05    1.10000  U 0.11068     63     18      0    0 FALSE FALSE
## hjn      9.0931e-05    1.10000  U 0.11068     89      0      0    0 FALSE FALSE
## nmkb     9.0937e-05    1.10000    0.11068    113      0      0    0 FALSE FALSE
## nlnm     9.0408e-05    1.10000  U 0.11071     46      0      0    0 FALSE FALSE
## hjkb     9.1553e-05    1.10000  U 0.11073    998      0      0    0 FALSE FALSE
## L-BFGS-B 1.0000e-04    1.00001    0.13519      6      6      0    0 FALSE FALSE
## lbfgsb3  1.0000e-04    1.00001    0.13519      6      6      0    0 FALSE FALSE
## bobyqa   1.2191e-04    0.82036    0.19365    221      0      0    0 FALSE FALSE
##          xtime
## nlminb   0.001
## Rcgmin   0.000
## Rtnmin   0.001
## nvm      0.001
## Rvmmin   0.001
## ncg      0.001
## slsqp    0.001
## tnewt    0.002
## spg      0.002
## hjn      0.001
## nmkb     0.005
## nlnm     0.001
```

```
## hjkb     0.009
## L-BFGS-B 0.001
## lbfgsb3  0.002
## bobyqa   0.001
## END : powell_bs
##
## next
## Problem: brown_bs
## about to call opm
## Warning in opm(x0, tfn, tgr, hess = the, lower = lo, upper = up, method =
## ameth, : Duplicate methods requested by user removed
## Warning in opm(x0, tfn, tgr, hess = the, lower = lo, upper = up, method =
## ameth, : 'snewtonm' removed from 'method' -- no hess()
## Warning in opm(x0, tfn, tgr, hess = the, lower = lo, upper = up, method =
## ameth, : 'snewtm' removed from 'method' -- no hess()
## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
```

```
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing
```

	p1	s1	p2	s2	value	fevals	gevals	hevals	conv	kkt1	kkt2	xtime
L-BFGS-B	1000000		2.0000e-06		2.6082e-29	24	24	0	0	TRUE	FALSE	0.001
nvm	1000000		2.0000e-06		4.0611e-27	41	19	0	0	TRUE	FALSE	0.002
Rvmmin	1000000		2.0000e-06		4.0611e-27	41	19	0	0	TRUE	FALSE	0.002
ncg	1000000		2.0000e-06		6.5594e-18	101	19	0	0	TRUE	FALSE	0.001
Rcgmin	1000000		2.0000e-06		1.7721e-13	128	35	0	0	TRUE	FALSE	0.002
lbfgsb3	1000000		2.0000e-06		4.7742e-12	21	21	0	0	FALSE	FALSE	0.004
nlminb	1000000		2.0000e-06		1.6451e-09	57	9	0	0	FALSE	FALSE	0.001
spg	1000000		2.0000e-06		2.6614e-06	61	12	0	0	FALSE	FALSE	0.002
slsqp	1000000		1.9987e-06		2.7135e-06	37	36	0	0	FALSE	FALSE	0.001
hjn	1000000		2.0480e-06		2.3040e-03	5283	0	0	0	FALSE	FALSE	0.028
nlnm	1000001		1.9424e-06		1.0747e+00	317	0	0	0	FALSE	FALSE	0.002
hjkb	1000000		3.8147e-06		3.2931e+00	5880	0	0	0	FALSE	FALSE	0.051
tnewt	500000		1.0000e+00		5.0000e+11	28	27	0	9999	NA	NA	0.001
bobyqa	73978		9.5792e-01		8.6254e+11	2618	0	0	3	FALSE	FALSE	0.010
Rtnmin	3001		9.9579e-01		9.9402e+11	900	900	0	2	TRUE	FALSE	0.036
nmkb	0		0.0000e+00		1.0000e+12	92	0	0	0	TRUE	FALSE	0.002

```
## END : brown_bs
##
## next
## Problem: beale
## about to call opm

## Warning in opm(x0, tfn, tgr, hess = the, lower = lo, upper = up, method =
## ameth, : Duplicate methods requested by user removed

## Warning in opm(x0, tfn, tgr, hess = the, lower = lo, upper = up, method =
## ameth, : 'snewtonm' removed from 'method' -- no hess()

## Warning in opm(x0, tfn, tgr, hess = the, lower = lo, upper = up, method =
## ameth, : 'snewtm' removed from 'method' -- no hess()
```

```
## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing
## Warning in minqa::bobyqa(par = spar, fn = efn, lower = slower, upper = supper,
## : All upper - lower must be >= 2*rhobeg. Changing rhobeg
## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing
##           p1 s1  p2 s2  value fevals gevals hevals conv  kkt1  kkt2 xtime
## L-BFGS-B 1.1  U 0.9  L 11.512      4      4      0    0 FALSE FALSE 0.000
## nlminb   1.1  U 0.9  L 11.512      4      3      0    0 FALSE FALSE 0.000
## Rcgmin   1.1  U 0.9  L 11.512      5      3      0    0 FALSE FALSE 0.001
```

```
## Rtnmin   1.1  U 0.9  L 11.512      6      6      0    0 FALSE FALSE 0.000
## nvm      1.1  U 0.9  L 11.512      3      3      0    2 FALSE FALSE 0.000
## Rvmmin   1.1  U 0.9  L 11.512      3      3      0    2 FALSE FALSE 0.001
## bobyqa   1.1  U 0.9  L 11.512     29      0      0    0 FALSE FALSE 0.001
## nmkb     1.1    0.9  L 11.512     17      0      0    0 FALSE FALSE 0.001
## hjn      1.1  U 0.9  L 11.512     29      0      0    0 FALSE FALSE 0.001
## ncg      1.1  U 0.9  L 11.512      5      3      0    0 FALSE FALSE 0.001
## slsqp    1.1  U 0.9  L 11.512      6      5      0    0 FALSE FALSE 0.001
## tnewt    1.1  U 0.9  L 11.512      5      4      0    0 FALSE FALSE 0.001
## nlnm     1.1  U 0.9  L 11.512     17      0      0    0 FALSE FALSE 0.001
## spg      1.1  U 0.9  L 11.512     16      5      0    0 FALSE FALSE 0.001
## lbfgsb3  1.1  U 0.9  L 11.512      4      4      0    0 FALSE FALSE 0.002
## hjkb     1.1    0.9  L 11.512     96      0      0    0 FALSE FALSE 0.001
## END : beale
##
## next
## Problem: jenn_samp
## about to call opm

## Warning in opm(x0, tfn, tgr, hess = the, lower = lo, upper = up, method =
## ameth, : Duplicate methods requested by user removed

## Warning in opm(x0, tfn, tgr, hess = the, lower = lo, upper = up, method =
## ameth, : 'snewtonm' removed from 'method' -- no hess()

## Warning in opm(x0, tfn, tgr, hess = the, lower = lo, upper = up, method =
## ameth, : 'snewtm' removed from 'method' -- no hess()

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Error in Line Search
##     ierror =  3
##     alpha  =  0
##     alpha0 =  1
##     gtp    =  -0.0011311
##     |g|     =  0.033631
##     |p|     =  0.033631

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing
```

```
## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing
##               p1 s1      p2 s2  value fevals gevals hevals conv kkt1 kkt2 xtime
## Rcgmin   0.25783    0.25783    124.36     46     19      0    0 TRUE TRUE 0.001
## nvm      0.25783    0.25783    124.36     17     14      0    0 TRUE TRUE 0.002
## Rvmmin   0.25783    0.25783    124.36     17     14      0    0 TRUE TRUE 0.001
## ncg      0.25783    0.25783    124.36     40     16      0    0 TRUE TRUE 0.001
## spg      0.25783    0.25783    124.36     31     13      0    0 TRUE TRUE 0.001
## tnewt    0.25783    0.25783    124.36     27     26      0    0 TRUE TRUE 0.002
## slsqp    0.25783    0.25783    124.36     23     22      0    0 TRUE TRUE 0.002
## bobyqa   0.25783    0.25783    124.36    107      0      0    0 TRUE TRUE 0.001
## nlminb   0.25783    0.25783    124.36     23     18      0    0 TRUE TRUE 0.000
## nlnm     0.25783    0.25783    124.36    106      0      0    0 TRUE TRUE 0.002
## hjn      0.25783    0.25783    124.36    218      0      0    0 TRUE TRUE 0.002
## L-BFGS-B 0.25783    0.25783    124.36     14     14      0    0 TRUE TRUE 0.000
## lbfgsb3  0.25783    0.25783    124.36     14     14      0    0 TRUE TRUE 0.003
## Rtnmin   0.25782    0.25783    124.36     42     42      0    3 TRUE TRUE 0.002
## hjkb     0.25782    0.25783    124.36    196      0      0    0 TRUE TRUE 0.002
## nmkb     0.25783    0.25782    124.36     82      0      0    0 TRUE TRUE 0.004
## END : jenn_samp
##
## next
## Problem: helical
## about to call opm

## Warning in opm(x0, tfn, tgr, hess = the, lower = lo, upper = up, method =
## ameth, : Duplicate methods requested by user removed

## Warning in opm(x0, tfn, tgr, hess = the, lower = lo, upper = up, method =
## ameth, : 'snewtonm' removed from 'method' -- no hess()

## Warning in opm(x0, tfn, tgr, hess = the, lower = lo, upper = up, method =
## ameth, : 'snewtm' removed from 'method' -- no hess()
```

```
## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing
##            p1 s1         p2 s2   p3 s3   value fevals gevals hevals conv  kkt1
## nvm       0.1  U -0.0899399    -1.1  L  76.552     47     24      0    0 FALSE
## Rvmmin    0.1  U -0.0899399    -1.1  L  76.552     47     24      0    0 FALSE
## slsqp     0.1  U -0.0899399    -1.1  L  76.552     32     31      0    0 FALSE
## hjn       0.1  U -0.0899399    -1.1  L  76.552    131      0      0    0 FALSE
## hjkb      0.1  U -0.0899414    -1.1  L  76.552    414      0      0    0 FALSE
```

```
## L-BFGS-B 0.1  U  0.0065247     0.1  U  80.973     14     14      0    0 FALSE
## nlminb   0.1  U  0.0065247     0.1  U  80.973     15     13      0    0 FALSE
## spg      0.1  U  0.0065247     0.1  U  80.973     42     23      0    0 FALSE
## lbfgsb3  0.1  U  0.0065247     0.1  U  80.973     14     14      0    0 FALSE
## Rcgmin   0.1     0.0065247     0.1  U  80.973     37     16      0    0 FALSE
## bobyqa   0.1  U  0.0065247     0.1  U  80.973     43      0      0    0 FALSE
## ncg      0.1     0.0065247     0.1  U  80.973     38     17      0    0 FALSE
## tnewt    0.1  U  0.0065247     0.1  U  80.973     17     16      0    0 FALSE
## nmkb     0.1     0.1000000     0.1    205.976     20      0      0    0 FALSE
## nlnm     0.1  U  0.1000000  U  0.1  U 205.976     33      0      0    0 FALSE
## Rtnmin   0.1     0.1000000     0.1  U 205.976      9      9      0    0 FALSE
##           kkt2 xtime
## nvm      FALSE 0.002
## Rvmmin   FALSE 0.002
## slsqp    FALSE 0.002
## hjn      FALSE 0.001
## hjkb     FALSE 0.004
## L-BFGS-B FALSE 0.000
## nlminb   FALSE 0.001
## spg      FALSE 0.002
## lbfgsb3  FALSE 0.004
## Rcgmin   FALSE 0.001
## bobyqa   FALSE 0.000
## ncg      FALSE 0.001
## tnewt    FALSE 0.001
## nmkb     FALSE 0.001
## nlnm     FALSE 0.001
## Rtnmin   FALSE 0.001
## END : helical
##
## next
## Problem: bard
## about to call opm

## Warning in opm(x0, tfn, tgr, hess = the, lower = lo, upper = up, method =
## ameth, : Duplicate methods requested by user removed

## Warning in opm(x0, tfn, tgr, hess = the, lower = lo, upper = up, method =
## ameth, : 'snewtonm' removed from 'method' -- no hess()

## Warning in opm(x0, tfn, tgr, hess = the, lower = lo, upper = up, method =
## ameth, : 'snewtm' removed from 'method' -- no hess()

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
```

```
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in minqa::bobyqa(par = spar, fn = efn, lower = slower, upper = supper,
## : All upper - lower must be >= 2*rhobeg. Changing rhobeg

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing
##           p1 s1  p2 s2  p3 s3  value fevals gevals hevals conv  kkt1 kkt2 xtime
## L-BFGS-B 0.9  L 1.1  U 1.1  U 29.147      2      2      0    0 FALSE TRUE 0.001
## nlminb   0.9  L 1.1  U 1.1  U 29.147      3      2      0    0 FALSE TRUE 0.000
## Rcgmin   0.9  L 1.1  U 1.1  U 29.147      7      6      0    0 FALSE TRUE 0.001
## Rtnmin   0.9  L 1.1  U 1.1  U 29.147     10     10      0    0 FALSE TRUE 0.001
## nvm      0.9  L 1.1  U 1.1  U 29.147      7      7      0    2 FALSE TRUE 0.001
## Rvmmin   0.9  L 1.1  U 1.1  U 29.147      7      7      0    2 FALSE TRUE 0.001
## bobyqa   0.9  L 1.1  U 1.1  U 29.147     24      0      0    0 FALSE TRUE 0.001
## nmkb     0.9  L 1.1  U 1.1  U 29.147     22      0      0    0 FALSE TRUE 0.002
## hjn      0.9  L 1.1  U 1.1  U 29.147     38      0      0    0 FALSE TRUE 0.001
## ncg      0.9  L 1.1  U 1.1  U 29.147      7      6      0    0 FALSE TRUE 0.001
## tnewt    0.9  L 1.1  U 1.1  U 29.147      6      5      0    0 FALSE TRUE 0.002
## nlnm     0.9  L 1.1  U 1.1  U 29.147     15      0      0    0 FALSE TRUE 0.001
## spg      0.9  L 1.1  U 1.1  U 29.147     28      3      0    0 FALSE TRUE 0.001
## lbfgsb3  0.9  L 1.1  U 1.1  U 29.147      2      2      0    0 FALSE TRUE 0.001
## slsqp    0.9  L 1.1    1.1    29.147      5      4      0    0 FALSE TRUE 0.002
## hjkb     0.9    1.1  U 1.1  U 29.147    130      0      0    0 FALSE TRUE 0.002
```

```
## END : bard
##
## next
## Problem: gauss
## about to call opm

## Warning in opm(x0, tfn, tgr, hess = the, lower = lo, upper = up, method =
## ameth, : Duplicate methods requested by user removed

## Warning in opm(x0, tfn, tgr, hess = the, lower = lo, upper = up, method =
## ameth, : 'snewtonm' removed from 'method' -- no hess()

## Warning in opm(x0, tfn, tgr, hess = the, lower = lo, upper = up, method =
## ameth, : 'snewtm' removed from 'method' -- no hess()

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing
```

```
## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

##               p1 s1      p2 s2          p3 s3      value fevals gevals hevals
## nvm      0.39896    1.00002     2.7880e-20    1.1279e-08     16      7      0
## Rvmmin   0.39896    1.00002     2.7880e-20    1.1279e-08     16      7      0
## nlminb   0.39896    1.00002     9.5920e-21    1.1279e-08      8      6      0
## slsqp    0.39896    1.00002     9.4187e-21    1.1279e-08     10      9      0
## ncg      0.39896    1.00002    -6.7724e-21    1.1279e-08     11      4      0
## Rcgmin   0.39896    1.00002     2.3299e-20    1.1279e-08     10      5      0
## tnewt    0.39896    1.00002     3.8162e-19    1.1279e-08      8      7      0
## hjn      0.39896    1.00002     0.0000e+00    1.1279e-08    200      0      0
## bobyqa   0.39896    1.00002    -9.5723e-09    1.1279e-08     73      0      0
## spg      0.39896    1.00002     3.0564e-20    1.1279e-08     40      7      0
## Rtnmin   0.39896    1.00002     6.5299e-22    1.1279e-08     29     29      0
## nlnm     0.39896    1.00002     1.9408e-08    1.1279e-08    128      0      0
## hjkb     0.39895    1.00002     0.0000e+00    1.1284e-08    250      0      0
## L-BFGS-B 0.39896    1.00007     1.5083e-21    1.1456e-08      6      6      0
## lbfgsb3  0.39896    1.00007     1.5083e-21    1.1456e-08      6      6      0
## nmkb     0.39862    0.99852    -5.8946e-04    3.9269e-07     62      0      0
##          conv  kkt1 kkt2 xtime
## nvm         0  TRUE TRUE 0.001
## Rvmmin      0  TRUE TRUE 0.001
## nlminb      0  TRUE TRUE 0.000
## slsqp       0  TRUE TRUE 0.002
## ncg         0  TRUE TRUE 0.001
## Rcgmin      0  TRUE TRUE 0.000
## tnewt       0  TRUE TRUE 0.002
## hjn         0  TRUE TRUE 0.002
## bobyqa      0  TRUE TRUE 0.001
## spg         0  TRUE TRUE 0.002
## Rtnmin      0  TRUE TRUE 0.002
## nlnm        0  TRUE TRUE 0.002
## hjkb        0  TRUE TRUE 0.002
## L-BFGS-B    0  TRUE TRUE 0.001
## lbfgsb3     0  TRUE TRUE 0.002
## nmkb        0 FALSE TRUE 0.003
## END : gauss
##
## next
## Problem: meyer
## about to call opm

## Warning in opm(x0, tfn, tgr, hess = the, lower = lo, upper = up, method =
## ameth, : Duplicate methods requested by user removed

## Warning in opm(x0, tfn, tgr, hess = the, lower = lo, upper = up, method =
## ameth, : 'snewtonm' removed from 'method' -- no hess()

## Warning in opm(x0, tfn, tgr, hess = the, lower = lo, upper = up, method =
## ameth, : 'snewtm' removed from 'method' -- no hess()
```

```
## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Error in Line Search
##     ierror =  3
##     alpha  =  0
##     alpha0 =  1.5561e-06
##     gtp    =  -1.4399e+11
##     |g|     =  379461
##     |p|     =  379461

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in BB::spg(par = spar, fn = efn, gr = egr, lower = slower, upper =
## supper, : Unsuccessful convergence.

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing
```

```
##                p1 s1     p2 s2     p3 s3      value fevals gevals hevals conv
## nvm      0.101960    4000.1    263.88        112030     84     52      0    0
## Rvmmin   0.101960    4000.1    263.88        112030     84     52      0    0
## tnewt    0.101960    4000.1  U 263.88        112030     48     47      0    0
## ncg      0.101960    4000.1  U 263.88        112030   1573    350      0    0
## nlminb   0.101960    4000.1  U 263.88        112030     38     24      0    0
## Rcgmin   0.101960    4000.1  U 263.88        112030    261     64      0    0
## nmkb     0.101960    4000.1  U 263.88        112030    372      0      0    0
## Rtnmin   0.101956    4000.1    263.88        112031     44     44      0    3
## nlnm     0.101974    4000.1    263.88        112037    152      0      0    0
## spg      0.101993    3999.9    263.87        112062   2722   1003      0    1
## hjn      0.102008    3999.9    263.87        112063  10000      0      0    1
## lbfgsb3  0.102058    3999.5    263.85        112123     35     35      0    0
## L-BFGS-B 0.102058    3999.5    263.85        112123     35     35      0    0
## hjkb     0.105449    3979.0    263.05        115181   4930      0      0    0
## bobyqa   0.098796    3994.8    262.62        148690   2021      0      0    0
## slsqp    0.020000    4000.0    250.00    1693607809      3      2      0 9999
##           kkt1  kkt2 xtime
## nvm      FALSE FALSE 0.004
## Rvmmin   FALSE FALSE 0.004
## tnewt    FALSE FALSE 0.002
## ncg      FALSE FALSE 0.016
## nlminb   FALSE FALSE 0.001
## Rcgmin   FALSE FALSE 0.003
## nmkb     FALSE FALSE 0.016
## Rtnmin   FALSE FALSE 0.003
## nlnm     FALSE FALSE 0.002
## spg      FALSE FALSE 0.091
## hjn      FALSE FALSE 0.061
## lbfgsb3  FALSE FALSE 0.006
## L-BFGS-B FALSE FALSE 0.001
## hjkb     FALSE FALSE 0.043
## bobyqa   FALSE FALSE 0.012
## slsqp       NA    NA 0.001
## END : meyer
##
## next
## Problem: gulf
## about to call opm
```

```
## Warning in opm(x0, tfn, tgr, hess = the, lower = lo, upper = up, method =
## ameth, : Duplicate methods requested by user removed
```

```
## Warning in opm(x0, tfn, tgr, hess = the, lower = lo, upper = up, method =
## ameth, : 'snewtonm' removed from 'method' -- no hess()
```

```
## Warning in opm(x0, tfn, tgr, hess = the, lower = lo, upper = up, method =
## ameth, : 'snewtm' removed from 'method' -- no hess()
```

```
## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing
```

```
## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing
```

```
## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
```

```
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing
##  Positive dir derivative in projection
##  Using the backtracking step

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

##           p1 s1  p2 s2      p3 s3 value fevals gevals hevals conv  kkt1  kkt2
## nvm      5.1  U 5.1  U 0.38598    6.441     40     12      0    2 FALSE FALSE
## Rvmmin   5.1  U 5.1  U 0.38598    6.441     40     12      0    2 FALSE FALSE
## L-BFGS-B 5.1  U 5.1  U 0.38598    6.441     26     26      0    0 FALSE FALSE
## nlminb   5.1  U 5.1  U 0.38598    6.441     16     12      0    0 FALSE FALSE
## Rcgmin   5.1  U 5.1  U 0.38598    6.441     27     14      0    0 FALSE FALSE
## Rtnmin   5.1  U 5.1  U 0.38598    6.441    518    518      0    2 FALSE FALSE
## ncg      5.1  U 5.1  U 0.38598    6.441     31     17      0    0 FALSE FALSE
## tnewt    5.1  U 5.1  U 0.38598    6.441   1446   1445      0    0 FALSE FALSE
## lbfgsb3  5.1  U 5.1  U 0.38598    6.441     27     27      0    0 FALSE FALSE
## slsqp    5.1  U 5.1    0.38598    6.441     18     17      0    0 FALSE FALSE
```

```
## bobyqa   5.1  U 5.1  U 0.38598    6.441     68      0      0    0 FALSE FALSE
## spg      5.1  U 5.1  U 0.38598    6.441    180    101      0    0 FALSE FALSE
## hjn      5.1  U 5.1  U 0.38598    6.441    310      0      0    0 FALSE FALSE
## hjkb     5.1  U 5.1  U 0.38598    6.441    300      0      0    0 FALSE FALSE
## nlnm     5.1  U 5.1  U 0.38598    6.441    141      0      0    0 FALSE FALSE
## nmkb     5.1    5.1    0.38598    6.441    119      0      0    0 FALSE FALSE
##          xtime
## nvm      0.002
## Rvmmin   0.002
## L-BFGS-B 0.001
## nlminb   0.000
## Rcgmin   0.001
## Rtnmin   0.019
## ncg      0.001
## tnewt    0.041
## lbfgsb3  0.000
## slsqp    0.001
## bobyqa   0.001
## spg      0.010
## hjn      0.004
## hjkb     0.005
## nlnm     0.003
## nmkb     0.006
## END : gulf
##
## next
## Problem: box_3d
## about to call opm

## Warning in opm(x0, tfn, tgr, hess = the, lower = lo, upper = up, method =
## ameth, : Duplicate methods requested by user removed

## Warning in opm(x0, tfn, tgr, hess = the, lower = lo, upper = up, method =
## ameth, : 'snewtonm' removed from 'method' -- no hess()

## Warning in opm(x0, tfn, tgr, hess = the, lower = lo, upper = up, method =
## ameth, : 'snewtm' removed from 'method' -- no hess()

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing
```

```
## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing
##                p1 s1      p2 s2          p3 s3      value fevals gevals hevals
## nvm       1.00000    10.0000     1.0000e+00    7.6267e-32     38     36      0
## Rvmmin    1.00000    10.0000     1.0000e+00    7.6267e-32     38     36      0
## tnewt     8.72569     8.7257    -5.6237e-13    4.1631e-24     21     20      0
## nlminb    2.26595     2.2659    -4.9348e-12    5.8353e-24     41     31      0
## Rcgmin    8.62840     8.6284    -6.1131e-12    1.6429e-22     26     15      0
## ncg       8.62919     8.6292     1.2378e-11    6.6905e-22     27     15      0
## slsqp     1.00000    10.0000     1.0000e+00    9.7753e-21     40     39      0
## Rtnmin    1.00000    10.0000     1.0000e+00    2.0444e-15     43     43      0
## hjn       5.15969     5.1597    -5.1200e-08    2.4598e-15   1000      0      0
## L-BFGS-B  1.00000    10.0000     1.0000e+00    1.7722e-14     25     25      0
## bobyqa    1.00000    10.0000     1.0000e+00    3.3640e-14    594      0      0
## lbfgsb3   1.00000    10.0000     1.0000e+00    2.4122e-12     24     24      0
## hjkb      1.00000    10.0000     1.0000e+00    4.3034e-12    600      0      0
## spg       0.99951    10.0151     1.0005e+00    1.8363e-07    429    337      0
## nlnm     -0.10000  L -0.1000  L -1.0000e-01  L 3.5925e-02     52      0      0
## nmkb     -0.10000    20.0996     2.2789e+00    5.8906e+00     91      0      0
##          conv  kkt1  kkt2 xtime
## nvm         2  TRUE  TRUE 0.003
## Rvmmin      2  TRUE  TRUE 0.003
## tnewt       0  TRUE FALSE 0.002
## nlminb      0  TRUE FALSE 0.001
## Rcgmin      0  TRUE FALSE 0.001
## ncg         0  TRUE FALSE 0.001
```

```
## slsqp       0  TRUE  TRUE 0.002
## Rtnmin      0  TRUE  TRUE 0.003
## hjn         0  TRUE FALSE 0.008
## L-BFGS-B    0  TRUE  TRUE 0.001
## bobyqa      0  TRUE  TRUE 0.005
## lbfgsb3     0  TRUE  TRUE 0.007
## hjkb        0  TRUE  TRUE 0.006
## spg         0  TRUE  TRUE 0.026
## nlnm        0 FALSE FALSE 0.002
## nmkb        0 FALSE  TRUE 0.005
## END : box_3d
##
## next
## Problem: powell_s
## about to call opm

## Warning in opm(x0, tfn, tgr, hess = the, lower = lo, upper = up, method =
## ameth, : Duplicate methods requested by user removed

## Warning in opm(x0, tfn, tgr, hess = the, lower = lo, upper = up, method =
## ameth, : 'snewtonm' removed from 'method' -- no hess()

## Warning in opm(x0, tfn, tgr, hess = the, lower = lo, upper = up, method =
## ameth, : 'snewtm' removed from 'method' -- no hess()

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

##                   p1 s1          p2 s2          p3 s3          p4 s4      value
## hjkb      0.0000e+00     0.0000e+00     0.0000e+00     0.0000e+00    0.0000e+00
## hjn       0.0000e+00     0.0000e+00     0.0000e+00     0.0000e+00    0.0000e+00
## slsqp     4.0876e-17    -4.0876e-18     1.1873e-18     1.1873e-18    3.6684e-65
```

```
## nlnm     -7.1691e-17     7.1691e-18    -3.2683e-17    -3.2683e-17    5.0834e-65
## nlminb   -1.5828e-12     1.5828e-13    -6.9996e-13    -6.9996e-13    1.3026e-47
## nvm      -2.0875e-06     2.0875e-07     1.9664e-06     1.9664e-06    2.8932e-21
## Rvmmin   -2.0875e-06     2.0875e-07     1.9664e-06     1.9664e-06    2.8932e-21
## Rtnmin   -5.2868e-05     5.2867e-06     3.1230e-04     3.1230e-04    3.2494e-13
## tnewt     7.3707e-04    -7.3707e-05     4.0463e-04     4.0463e-04    7.2997e-13
## bobyqa    2.2667e-03    -2.2667e-04     1.0667e-03     1.0667e-03    5.1761e-11
## ncg       3.0291e-03    -3.0291e-04     1.6122e-03     1.6123e-03    1.9511e-10
## Rcgmin    3.7074e-03    -3.7073e-04     2.2076e-03     2.2077e-03    5.7525e-10
## L-BFGS-B -5.0977e-03     5.1136e-04    -1.6547e-03    -1.6497e-03    2.0021e-09
## lbfgsb3  -5.0977e-03     5.1136e-04    -1.6547e-03    -1.6497e-03    2.0021e-09
## spg       2.7040e-02    -2.7036e-03     1.3469e-02     1.3482e-02    1.1108e-06
## nmkb     -3.3175e-02     3.3779e-03    -1.8378e-02    -1.8333e-02    3.4558e-06
##          fevals gevals hevals conv  kkt1  kkt2 xtime
## hjkb        263      0      0    0  TRUE FALSE 0.002
## hjn         120      0      0    0  TRUE FALSE 0.001
## slsqp       253    252      0 9999    NA    NA 0.004
## nlnm       1828      0      0    0  TRUE FALSE 0.008
## nlminb      153    151      0    1  TRUE FALSE 0.001
## nvm          70     67      0    2  TRUE FALSE 0.004
## Rvmmin       70     67      0    2  TRUE FALSE 0.005
## Rtnmin       82     82      0    0  TRUE FALSE 0.005
## tnewt        67     66      0    0  TRUE FALSE 0.001
## bobyqa     1784      0      0    0  TRUE FALSE 0.008
## ncg         250     99      0    0  TRUE FALSE 0.004
## Rcgmin      207     85      0    0  TRUE  TRUE 0.003
## L-BFGS-B     43     43      0    0  TRUE  TRUE 0.001
## lbfgsb3      43     43      0    0  TRUE  TRUE 0.008
## spg         820    643      0    0  TRUE  TRUE 0.042
## nmkb        569      0      0    0 FALSE  TRUE 0.026
## END : powell_s
##
## next
## Problem: wood
## about to call opm
## Warning in opm(x0, tfn, tgr, hess = the, lower = lo, upper = up, method =
## ameth, : Duplicate methods requested by user removed
## Warning in opm(x0, tfn, tgr, hess = the, lower = lo, upper = up, method =
## ameth, : 'snewtonm' removed from 'method' -- no hess()
## Warning in opm(x0, tfn, tgr, hess = the, lower = lo, upper = up, method =
## ameth, : 'snewtm' removed from 'method' -- no hess()
## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing
## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing
## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing
## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing
```

```
## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing
##            p1 s1   p2 s2   p3 s3   p4 s4 value fevals gevals hevals conv  kkt1
## nmkb     -0.9  U -0.9  U -0.9  U -0.9  U 707.2     24      0      0    0 FALSE
## L-BFGS-B -0.9  U -0.9  U -0.9  U -0.9  U 707.2      2      2      0    0 FALSE
## nlminb   -0.9  U -0.9  U -0.9  U -0.9  U 707.2      6      5      0    0 FALSE
## Rcgmin   -0.9  U -0.9  U -0.9  U -0.9  U 707.2     11     10      0    0 FALSE
## Rtnmin   -0.9  U -0.9  U -0.9  U -0.9  U 707.2     16     16      0    0 FALSE
## nvm      -0.9  U -0.9  U -0.9  U -0.9  U 707.2     15     13      0    2 FALSE
## Rvmmin   -0.9  U -0.9  U -0.9  U -0.9  U 707.2     15     13      0    2 FALSE
## bobyqa   -0.9  U -0.9  U -0.9  U -0.9  U 707.2     39      0      0    0 FALSE
## hjn      -0.9  U -0.9  U -0.9  U -0.9  U 707.2     53      0      0    0 FALSE
## ncg      -0.9  U -0.9  U -0.9  U -0.9  U 707.2     11     10      0    0 FALSE
## slsqp    -0.9  U -0.9  U -0.9  U -0.9  U 707.2      4      3      0    0 FALSE
## tnewt    -0.9  U -0.9  U -0.9  U -0.9  U 707.2      7      6      0    0 FALSE
## nlnm     -0.9  U -0.9  U -0.9  U -0.9  U 707.2     37      0      0    0 FALSE
## spg      -0.9  U -0.9  U -0.9  U -0.9  U 707.2     36      3      0    0 FALSE
## lbfgsb3  -0.9  U -0.9  U -0.9  U -0.9  U 707.2      2      2      0    0 FALSE
## hjkb     -0.9  U -0.9    -0.9  U -0.9  U 707.2    199      0      0    0 FALSE
```

```
##          kkt2 xtime
## nmkb     TRUE 0.001
## L-BFGS-B TRUE 0.000
## nlminb   TRUE 0.000
## Rcgmin   TRUE 0.001
## Rtnmin   TRUE 0.001
## nvm      TRUE 0.001
## Rvmmin   TRUE 0.002
## bobyqa   TRUE 0.000
## hjn      TRUE 0.000
## ncg      TRUE 0.001
## slsqp    TRUE 0.001
## tnewt    TRUE 0.002
## nlnm     TRUE 0.001
## spg      TRUE 0.001
## lbfgsb3  TRUE 0.001
## hjkb     TRUE 0.002
## END : wood
##
## next
## Problem: kow_osb
## about to call opm

## Warning in opm(x0, tfn, tgr, hess = the, lower = lo, upper = up, method =
## ameth, : Duplicate methods requested by user removed

## Warning in opm(x0, tfn, tgr, hess = the, lower = lo, upper = up, method =
## ameth, : 'snewtonm' removed from 'method' -- no hess()

## Warning in opm(x0, tfn, tgr, hess = the, lower = lo, upper = up, method =
## ameth, : 'snewtm' removed from 'method' -- no hess()

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing
```

```
## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

##  Positive dir derivative in projection
##  Using the backtracking step

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

##               p1 s1      p2 s2      p3 s3      p4 s4      value fevals gevals
## tnewt    0.19299    0.22736    0.15000  L 0.15000  L 0.00031208     43     42
## slsqp    0.19299    0.22736    0.15000    0.15000    0.00031208     31     30
## nvm      0.19299    0.22736    0.15000  L 0.15000    0.00031208    104     59
## Rvmmin   0.19299    0.22736    0.15000  L 0.15000    0.00031208    104     59
## bobyqa   0.19299    0.22736    0.15000  L 0.15000  L 0.00031208    514      0
## nlminb   0.19299    0.22736    0.15000  L 0.15000  L 0.00031208     30     27
## ncg      0.19299    0.22736    0.15000  L 0.15000  L 0.00031208    140     64
## lbfgsb3  0.19299    0.22736    0.15000  L 0.15000  L 0.00031208     36     36
## hjn      0.19299    0.22736    0.15000  L 0.15000  L 0.00031208    879      0
## Rcgmin   0.19299    0.22736    0.15000  L 0.15000  L 0.00031208    127     61
## hjkb     0.19299    0.22736    0.15000  L 0.15000  L 0.00031208    591      0
## L-BFGS-B 0.19299    0.22737    0.15000  L 0.15000  L 0.00031208     36     36
## spg      0.19292    0.22826    0.15000  L 0.15036    0.00031210    262    178
## nmkb     0.18411    0.48975    0.22962    0.25828    0.00037319    120      0
## nlnm     0.18304    0.51500  U 0.23371    0.26783    0.00038008    204      0
## Rtnmin   0.18304    0.51500  U 0.23371    0.26783    0.00038008     24     24
##          hevals conv kkt1  kkt2 xtime
## tnewt         0    0 TRUE  TRUE 0.002
## slsqp         0    0 TRUE  TRUE 0.002
## nvm           0    0 TRUE  TRUE 0.006
## Rvmmin        0    0 TRUE  TRUE 0.006
## bobyqa        0    0 TRUE  TRUE 0.005
## nlminb        0    0 TRUE  TRUE 0.001
## ncg           0    0 TRUE  TRUE 0.003
## lbfgsb3       0    0 TRUE  TRUE 0.006
## hjn           0    0 TRUE  TRUE 0.009
## Rcgmin        0    0 TRUE  TRUE 0.003
```

```
## hjkb          0    0 TRUE  TRUE 0.007
## L-BFGS-B      0    0 TRUE  TRUE 0.002
## spg           0    0 TRUE  TRUE 0.015
## nmkb          0    0 TRUE FALSE 0.006
## nlnm          0    0 TRUE FALSE 0.003
## Rtnmin        0    0 TRUE FALSE 0.002
## END : kow_osb
##
## next
## Problem: brown_den
## about to call opm

## Warning in opm(x0, tfn, tgr, hess = the, lower = lo, upper = up, method =
## ameth, : Duplicate methods requested by user removed

## Warning in opm(x0, tfn, tgr, hess = the, lower = lo, upper = up, method =
## ameth, : 'snewtonm' removed from 'method' -- no hess()

## Warning in opm(x0, tfn, tgr, hess = the, lower = lo, upper = up, method =
## ameth, : 'snewtm' removed from 'method' -- no hess()

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Error in Line Search
##     ierror =  3
##     alpha  =  0
##     alpha0 =  1
##     gtp    =  -0.0077229
##     |g|     =  0.08788
##     |p|     =  0.08788

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
```

```
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing
##             p1 s1     p2 s2       p3 s3       p4 s4   value fevals gevals hevals
## nvm       -5.1  L 11.060    -0.61781     0.23871     128127     34     18      0
## Rvmmin    -5.1  L 11.060    -0.61781     0.23871     128127     34     18      0
## lbfgsb3   -5.1  L 11.060    -0.61781     0.23871     128127     24     24      0
## ncg       -5.1  L 11.060    -0.61781     0.23871     128127     72     24      0
## nlminb    -5.1  L 11.060    -0.61781     0.23871     128127     53     45      0
## spg       -5.1  L 11.060    -0.61781     0.23871     128127    103     69      0
## tnewt     -5.1  L 11.060    -0.61781     0.23871     128127     32     31      0
## hjn       -5.1  L 11.060    -0.61781     0.23871     128127    497      0      0
## Rcgmin    -5.1  L 11.060    -0.61781     0.23871     128127     65     28      0
## bobyqa    -5.1  L 11.060    -0.61781     0.23870     128127    334      0      0
## nlnm      -5.1  L 11.060    -0.61781     0.23870     128127    569      0      0
## hjkb      -5.1  L 11.060    -0.61781     0.23871     128127    533      0      0
## Rtnmin    -5.1    11.060    -0.61782     0.23871     128127     42     42      0
## L-BFGS-B -5.1  L 11.060    -0.61783     0.23870     128127     22     22      0
## nmkb      -5.1    11.105     0.98087    -5.10000     160260    570      0      0
## slsqp     25.0     5.000    -5.00000     1.00000    7632895      3      2      0
##          conv  kkt1 kkt2 xtime
## nvm         0 FALSE TRUE 0.002
## Rvmmin      0 FALSE TRUE 0.002
## lbfgsb3     0 FALSE TRUE 0.003
## ncg         0 FALSE TRUE 0.002
## nlminb      0 FALSE TRUE 0.001
## spg         0 FALSE TRUE 0.006
## tnewt       0 FALSE TRUE 0.001
## hjn         0 FALSE TRUE 0.004
## Rcgmin      0 FALSE TRUE 0.002
## bobyqa      0 FALSE TRUE 0.003
## nlnm        0 FALSE TRUE 0.004
## hjkb        0 FALSE TRUE 0.005
## Rtnmin      3 FALSE TRUE 0.003
## L-BFGS-B    0 FALSE TRUE 0.001
## nmkb        0 FALSE TRUE 0.027
## slsqp       0 FALSE TRUE 0.001
```

```
## END : brown_den
##
## next
## Problem: osborne_1
## about to call opm

## Warning in opm(x0, tfn, tgr, hess = the, lower = lo, upper = up, method =
## ameth, : 'snewtonm' removed from 'method' -- no hess()

## Warning in opm(x0, tfn, tgr, hess = the, lower = lo, upper = up, method =
## ameth, : 'snewtm' removed from 'method' -- no hess()

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Error in Line Search
##     ierror =  3
##     alpha  =  0
##     alpha0 =  1
##     gtp    =  -2.0653e-06
##     |g|     =  0.0014371
##     |p|     =  0.0014371

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in dfoptim::hjkb(par = spar, fn = efn, lower = slower, upper = supper,
## : Function evaluation limit exceeded -- may not converge.

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
```

```
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

##              p1 s1     p2 s2       p3 s3        p4 s4       p5 s5      value
## nvm     0.37073    1.5748    -1.10000  L 0.0119506    0.024142    6.6112e-05
## Rvmmin  0.37073    1.5748    -1.10000  L 0.0119506    0.024142    6.6112e-05
## ncg     0.37073    1.5748    -1.10000  L 0.0119506    0.024142    6.6112e-05
## nlminb  0.37073    1.5748    -1.10000  L 0.0119506    0.024142    6.6112e-05
## tnewt   0.37073    1.5748    -1.10000  L 0.0119506    0.024142    6.6112e-05
## slsqp   0.37073    1.5748    -1.10000  L 0.0119506    0.024142    6.6112e-05
## Rcgmin  0.37073    1.5748    -1.10000  L 0.0119506    0.024142    6.6112e-05
## nlnm    0.37074    1.5748    -1.10000    0.0119506    0.024142    6.6112e-05
## Rtnmin  0.36960    1.5196    -1.04399    0.0117678    0.024599    7.2360e-05
## spg     0.36947    1.4858    -1.01084    0.0116739    0.024972    7.8799e-05
## nmkb    0.36888    1.4749    -0.99867    0.0116204    0.025038    7.9708e-05
## lbfgsb3 0.36806    1.4563    -0.97939    0.0115378    0.025197    8.2953e-05
## hjkb    0.35972    1.2547    -0.77067    0.0105875    0.027896    1.7184e-04
## hjn     0.37502    1.4890    -1.02071    0.0118867    0.025304    1.7308e-04
## bobyqa  0.34618    1.0750    -0.58030    0.0093813    0.032926    4.9556e-04
##         fevals gevals hevals conv  kkt1  kkt2 xtime
## nvm         69     33      0    0  TRUE FALSE 0.003
## Rvmmin      69     33      0    0  TRUE FALSE 0.004
## ncg        506    171      0    0  TRUE FALSE 0.009
## nlminb      54     29      0    0  TRUE FALSE 0.001
## tnewt       67     66      0    0  TRUE FALSE 0.002
## slsqp       59     58      0    0  TRUE FALSE 0.002
## Rcgmin     392    146      0    0  TRUE FALSE 0.006
## nlnm       804      0      0    0 FALSE FALSE 0.006
## Rtnmin      42     42      0    3 FALSE FALSE 0.003
## spg       1328    921      0    0 FALSE FALSE 0.077
## nmkb       175      0      0    0 FALSE FALSE 0.008
## lbfgsb3     46     46      0    0  TRUE FALSE 0.006
## hjkb     10007      0      0    1 FALSE FALSE 0.083
## hjn      10000      0      0    1 FALSE FALSE 0.069
## bobyqa   10002      0      0    1 FALSE FALSE 0.076
## END : osborne_1
##
## next
## Problem: biggs_exp6
## about to call opm

## Warning in opm(x0, tfn, tgr, hess = the, lower = lo, upper = up, method =
## ameth, : Duplicate methods requested by user removed

## Warning in opm(x0, tfn, tgr, hess = the, lower = lo, upper = up, method =
## ameth, : 'snewtonm' removed from 'method' -- no hess()

## Warning in opm(x0, tfn, tgr, hess = the, lower = lo, upper = up, method =
```

```
## ameth, : 'snewtm' removed from 'method' -- no hess()

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

##  Positive dir derivative in projection
##  Using the backtracking step
##  Positive dir derivative in projection
##  Using the backtracking step

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

##              p1 s1   p2 s2     p3 s3     p4 s4     p5 s5   value fevals gevals
```

```
## ncg      1.5881    2.10  U 1.8344    2.1000  U 1.5881    0.26899     51     35
## nvm      1.5881    2.10  U 1.8344    2.1000  U 1.5881    0.26899     39     27
## Rvmmin   1.5881    2.10  U 1.8344    2.1000  U 1.5881    0.26899     39     27
## tnewt    1.5881    2.10  U 1.8344    2.1000  U 1.5881    0.26899     38     37
## nlminb   1.5881    2.10  U 1.8344    2.1000  U 1.5881    0.26899     22     20
## slsqp    1.5881    2.10  U 1.8344    2.1000    1.5881    0.26899     24     23
## Rcgmin   1.5881    2.10  U 1.8344    2.1000  U 1.5881    0.26899     52     34
## hjn      1.5881    2.10  U 1.5759    2.1000  U 1.5881    0.26899   1135      0
## bobyqa   1.5881    2.10  U 1.8995    2.1000  U 1.5881    0.26899    465      0
## nlnm     1.5881    2.10    1.5763    2.1000    1.5881    0.26899   2231      0
## L-BFGS-B 1.5881    2.10  U 1.8344    2.1000  U 1.5881    0.26899     24     24
## hjkb     1.5881    2.10  U 1.8001    2.1000  U 1.5881    0.26899    995      0
## lbfgsb3  1.5881    2.10  U 1.8344    2.1000  U 1.5881    0.26899     26     26
## spg      1.5881    2.10  U 1.8344    2.1000  U 1.5881    0.26899    211    135
## nmkb     1.5553    2.08    1.1953    1.7147    1.5313    0.27442    620      0
## Rtnmin   1.4300    2.10  U 1.2557    0.9000  L 1.4300    0.28488     24     24
##          hevals conv  kkt1  kkt2 xtime
## ncg           0    0 FALSE FALSE 0.004
## nvm           0    0 FALSE FALSE 0.005
## Rvmmin        0    0 FALSE FALSE 0.001
## tnewt         0    0 FALSE FALSE 0.000
## nlminb        0    0 FALSE FALSE 0.001
## slsqp         0    0 FALSE FALSE 0.003
## Rcgmin        0    0 FALSE FALSE 0.003
## hjn           0    0 FALSE FALSE 0.013
## bobyqa        0    0 FALSE FALSE 0.004
## nlnm          0    0 FALSE FALSE 0.014
## L-BFGS-B      0    0 FALSE FALSE 0.001
## hjkb          0    0 FALSE FALSE 0.010
## lbfgsb3       0    0 FALSE FALSE 0.005
## spg           0    0 FALSE FALSE 0.017
## nmkb          0    0 FALSE FALSE 0.034
## Rtnmin        0    0 FALSE FALSE 0.004
## END : biggs_exp6
##
## next
## Problem: osborne_2
## about to call opm

## Warning in opm(x0, tfn, tgr, hess = the, lower = lo, upper = up, method =
## ameth, : Duplicate methods requested by user removed

## Warning in opm(x0, tfn, tgr, hess = the, lower = lo, upper = up, method =
## ameth, : 'snewtonm' removed from 'method' -- no hess()

## Warning in opm(x0, tfn, tgr, hess = the, lower = lo, upper = up, method =
## ameth, : 'snewtm' removed from 'method' -- no hess()

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing
```

```
## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing
##  Positive dir derivative in projection
##  Using the backtracking step
## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing
##              p1 s1      p2 s2      p3 s3      p4 s4      p5 s5   value fevals
## nvm      1.3316    0.50000  L 0.64392    0.63248    0.93048    0.04527    110
## Rvmmin   1.3316    0.50000  L 0.64392    0.63248    0.93048    0.04527    110
## tnewt    1.3316    0.50000  L 0.64392    0.63248    0.93048    0.04527    107
## hjn      1.3316    0.50000  L 0.64392    0.63248    0.93048    0.04527   8033
## slsqp    1.3316    0.50000  L 0.64392    0.63248    0.93048    0.04527     82
## nlminb   1.3316    0.50000  L 0.64392    0.63248    0.93048    0.04527     68
## ncg      1.3316    0.50000  L 0.64392    0.63248    0.93048    0.04527    482
## bobyqa   1.3316    0.50000  L 0.64392    0.63248    0.93048    0.04527   4032
## Rcgmin   1.3316    0.50000  L 0.64392    0.63248    0.93048    0.04527    476
## nlnm     1.3316    0.50000    0.64392    0.63248    0.93048    0.04527  14561
## hjkb     1.3316    0.50000  L 0.64392    0.63249    0.93048    0.04527   7968
```

```
## lbfgsb3  1.3316    0.50000  L 0.64393    0.63244    0.93042    0.04527    151
## spg      1.3316    0.50000  L 0.64397    0.63228    0.93044    0.04527   1668
## L-BFGS-B 1.3317    0.50000  L 0.64391    0.63219    0.93039    0.04527    144
## nmkb     1.3111    0.51285    0.64396    0.52371    1.03415    0.06915   1903
## Rtnmin   1.1913    0.50000  L 0.50000  L 0.51785    0.50000  L 0.30911     60
##          gevals hevals conv  kkt1  kkt2 xtime
## nvm          65      0    0 FALSE  TRUE 0.010
## Rvmmin       65      0    0 FALSE  TRUE 0.018
## tnewt       106      0    0 FALSE  TRUE 0.005
## hjn           0      0    0 FALSE  TRUE 0.092
## slsqp        81      0    0 FALSE  TRUE 0.012
## nlminb       50      0    0 FALSE  TRUE 0.010
## ncg         214      0    0 FALSE  TRUE 0.022
## bobyqa        0      0    0 FALSE  TRUE 0.076
## Rcgmin      211      0    0 FALSE  TRUE 0.022
## nlnm          0      0    0 FALSE  TRUE 0.164
## hjkb          0      0    0 FALSE  TRUE 0.124
## lbfgsb3     151      0    0 FALSE  TRUE 0.030
## spg        1367      0    0 FALSE  TRUE 0.139
## L-BFGS-B    144      0    0 FALSE  TRUE 0.004
## nmkb          0      0    0 FALSE FALSE 0.145
## Rtnmin       60      0    0 FALSE  TRUE 0.004
## END : osborne_2
##
## next
## Problem: watson
## about to call opm

## Warning in opm(x0, tfn, tgr, hess = the, lower = lo, upper = up, method =
## ameth, : Duplicate methods requested by user removed

## Warning in opm(x0, tfn, tgr, hess = the, lower = lo, upper = up, method =
## ameth, : 'snewtonm' removed from 'method' -- no hess()

## Warning in opm(x0, tfn, tgr, hess = the, lower = lo, upper = up, method =
## ameth, : 'snewtm' removed from 'method' -- no hess()

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Error in commonArgs(par, fn, control, environment()) :
```

```
##   0 < ctrl$rhoend is not TRUE

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing
##                  p1 s1  p2 s2  p3 s3  p4 s4  p5 s5       value fevals gevals
## nvm      -0.052603    0.1  U 0.1  U 0.1  U 0.1  U  1.1754e+01     50     34
## Rvmmin   -0.052603    0.1  U 0.1  U 0.1  U 0.1  U  1.1754e+01     50     34
## lbfgsb3  -0.052603    0.1  U 0.1  U 0.1  U 0.1  U  1.1754e+01     15     15
## L-BFGS-B -0.052603    0.1  U 0.1  U 0.1  U 0.1  U  1.1754e+01     15     15
## Rcgmin   -0.052603    0.1  U 0.1  U 0.1  U 0.1  U  1.1754e+01     50     30
## ncg      -0.052603    0.1  U 0.1  U 0.1  U 0.1  U  1.1754e+01     50     30
## tnewt    -0.052603    0.1  U 0.1  U 0.1  U 0.1  U  1.1754e+01     36     35
## nlminb   -0.052603    0.1  U 0.1  U 0.1  U 0.1  U  1.1754e+01     19     16
## hjn      -0.052603    0.1  U 0.1  U 0.1  U 0.1  U  1.1754e+01    517      0
## spg      -0.052603    0.1  U 0.1  U 0.1  U 0.1  U  1.1754e+01     93     34
## slsqp    -0.052603    0.1  U 0.1  U 0.1  U 0.1  U  1.1754e+01     14     13
## hjkb     -0.052602    0.1  U 0.1  U 0.1  U 0.1  U  1.1754e+01    378      0
## nlnm     -0.052602    0.1    0.1    0.1    0.1     1.1754e+01   7403      0
## Rtnmin   -0.100000  L 0.1  U 0.1  U 0.1  U 0.1  U  1.1831e+01     30     30
## nmkb     -0.053946    0.1    0.1    0.1    0.1     1.2194e+01    295      0
## bobyqa          NA     NA     NA     NA     NA    8.9885e+307      0      0
##          hevals conv  kkt1  kkt2 xtime
## nvm           0    0 FALSE FALSE 0.008
## Rvmmin        0    0 FALSE FALSE 0.016
## lbfgsb3       0    0 FALSE FALSE 0.008
## L-BFGS-B      0    0 FALSE FALSE 0.004
## Rcgmin        0    0 FALSE FALSE 0.007
## ncg           0    0 FALSE FALSE 0.007
## tnewt         0    0 FALSE FALSE 0.011
## nlminb        0    0 FALSE FALSE 0.001
```

```
## hjn          0    0 FALSE FALSE 0.040
## spg          0    0 FALSE FALSE 0.017
## slsqp        0    0 FALSE FALSE 0.005
## hjkb         0    0 FALSE FALSE 0.019
## nlnm         0    0 FALSE FALSE 0.432
## Rtnmin       0    0 FALSE FALSE 0.006
## nmkb         0    0 FALSE FALSE 0.037
## bobyqa       0 9999    NA    NA 0.001
## END : watson
##
## next
## Problem: ex_rosen
## about to call opm

## Warning in opm(x0, tfn, tgr, hess = the, lower = lo, upper = up, method =
## ameth, : Duplicate methods requested by user removed

## Warning in opm(x0, tfn, tgr, hess = the, lower = lo, upper = up, method =
## ameth, : 'snewtonm' removed from 'method' -- no hess()

## Warning in opm(x0, tfn, tgr, hess = the, lower = lo, upper = up, method =
## ameth, : 'snewtm' removed from 'method' -- no hess()

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing
```

```
## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing
##               p1 s1      p2 s2      p3 s3      p4 s4      p5 s5      value
## nvm      1.00000    1.00000    1.00000    1.00000    1.00000    1.1143e-29
## Rvmmin   1.00000    1.00000    1.00000    1.00000    1.00000    1.1143e-29
## L-BFGS-B 1.00000    1.00000    1.00000    1.00000    1.00000    2.4857e-20
## tnewt    1.00000    1.00000    1.00000    1.00000    1.00000    5.7852e-20
## ncg      1.00000    1.00000    1.00000    1.00000    1.00000    1.3989e-14
## slsqp    1.00000    1.00000    1.00000    1.00000    1.00000    8.6753e-14
## lbfgsb3  1.00000    1.00000    1.00000    1.00000    1.00000    2.1835e-13
## Rcgmin   1.00000    1.00000    1.00000    1.00000    1.00000    2.2691e-13
## Rtnmin   1.00000    1.00000    1.00000    1.00000    1.00000    2.9955e-13
## bobyqa   1.00000    1.00000    1.00001    1.00002    1.00000    1.7905e-10
## spg      1.00004    1.00007    1.00004    1.00007    1.00004    6.6436e-09
## hjkb     1.00034    1.00068    0.99962    0.99923    1.00043    4.8465e-07
## hjn      1.00216    1.00433    1.00061    1.00121    1.00061    6.1523e-06
## nlnm     0.95657    0.91457    1.02645    1.05470    1.00995    5.1312e-03
## nlminb   0.83326    0.69704    0.78228    0.61133    0.82807    1.8236e-01
## nmkb     0.96666    0.93445    0.99390    0.98774    1.01503    4.1899e+00
##          fevals gevals hevals conv  kkt1  kkt2 xtime
## nvm         138     85      0    0  TRUE  TRUE 0.007
## Rvmmin      138     85      0    0  TRUE  TRUE 0.008
## L-BFGS-B     20     20      0    0  TRUE  TRUE 0.000
## tnewt        65     64      0    0  TRUE  TRUE 0.002
## ncg         137     63      0    0  TRUE  TRUE 0.004
## slsqp       163    162      0    0  TRUE  TRUE 0.003
## lbfgsb3      19     19      0    0  TRUE  TRUE 0.003
## Rcgmin      343    212      0    0  TRUE  TRUE 0.008
## Rtnmin       83     83      0    0  TRUE  TRUE 0.005
## bobyqa     5729      0      0    0  TRUE  TRUE 0.046
## spg         102     20      0    0  TRUE  TRUE 0.003
## hjkb       6923      0      0    0 FALSE  TRUE 0.044
## hjn       15001      0      0    1 FALSE  TRUE 0.079
## nlnm      15002      0      0    0 FALSE  TRUE 0.072
## nlminb      165    151      0    1 FALSE  TRUE 0.004
## nmkb       2841      0      0    0 FALSE FALSE 0.161
## END : ex_rosen
##
## next
## Problem: ex_powell
## about to call opm
```

```
## Warning in opm(x0, tfn, tgr, hess = the, lower = lo, upper = up, method =
## ameth, : Duplicate methods requested by user removed

## Warning in opm(x0, tfn, tgr, hess = the, lower = lo, upper = up, method =
## ameth, : 'snewtonm' removed from 'method' -- no hess()

## Warning in opm(x0, tfn, tgr, hess = the, lower = lo, upper = up, method =
## ameth, : 'snewtm' removed from 'method' -- no hess()

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing
##                   p1 s1          p2 s2          p3 s3          p4 s4
## hjkb      0.0000e+00     0.0000e+00     0.0000e+00     0.0000e+00
## slsqp    -3.8527e-12     3.8527e-13     1.8940e-11     1.8940e-11
## nvm      -5.1345e-06     5.1345e-07    -2.3901e-06    -2.3901e-06
## Rvmmin   -5.1345e-06     5.1345e-07    -2.3901e-06    -2.3901e-06
## nlminb    2.5169e-05    -2.5169e-06     3.9462e-05     3.9462e-05
## Rtnmin    2.3948e-05    -2.3949e-06    -1.3314e-04    -1.3314e-04
## tnewt     7.3709e-04    -7.3709e-05     4.0464e-04     4.0464e-04
## ncg       4.2196e-03    -4.2196e-04     1.8823e-03     1.8824e-03
## lbfgsb3  -5.2466e-03     5.2465e-04    -2.0939e-03    -2.0935e-03
## Rcgmin    5.4286e-03    -5.4286e-04     2.8310e-03     2.8311e-03
```

```
## L-BFGS-B -6.1081e-03     6.1011e-04    -2.2198e-03    -2.2190e-03
## bobyqa   -9.9933e-03     9.9930e-04    -5.2872e-03    -5.2889e-03
## hjn       1.6934e-02    -1.6922e-03     7.5648e-03     7.5674e-03
## spg       2.3906e-02    -2.3930e-03     1.1905e-02     1.1923e-02
## nlnm      4.9117e-01    -5.0194e-02     1.9792e-01     2.5737e-01
## nmkb      3.0997e+00    -2.6477e-01     5.2360e-01     2.3321e+00
##                  p5 s5      value fevals gevals hevals conv  kkt1  kkt2 xtime
## hjkb      0.0000e+00    0.0000e+00   1319      0      0    0  TRUE FALSE 0.014
## slsqp     4.2158e-12    1.0095e-41    720    719      0    0  TRUE FALSE 0.050
## nvm       5.6017e-06    1.4147e-20    319    292      0    2  TRUE FALSE 0.042
## Rvmmin    5.6017e-06    1.4147e-20    319    292      0    2  TRUE FALSE 0.065
## nlminb    6.1971e-05    4.4076e-15    181    151      0    1  TRUE FALSE 0.010
## Rtnmin    2.3948e-05    5.4691e-14     83     83      0    0  TRUE FALSE 0.007
## tnewt     7.3709e-04    3.6501e-12     68     67      0    0  TRUE FALSE 0.008
## ncg       4.2196e-03    3.0283e-09    267    106      0    0  TRUE  TRUE 0.019
## lbfgsb3  -5.2466e-03    7.4125e-09     45     45      0    0  TRUE  TRUE 0.018
## Rcgmin    5.4286e-03    9.6877e-09    250    105      0    0  TRUE  TRUE 0.025
## L-BFGS-B -6.1081e-03    1.6038e-08     47     47      0    0  TRUE  TRUE 0.001
## bobyqa   -1.0002e-02    1.0339e-07  25002      0      0    1  TRUE  TRUE 0.504
## hjn       5.5511e-17    1.5726e-07  25000      0      0    1  TRUE FALSE 0.169
## spg       2.3906e-02    3.3988e-06   1161    818      0    0  TRUE  TRUE 0.121
## nlnm      3.8766e-01    2.0953e-01  25002      0      0    0 FALSE  TRUE 0.226
## nmkb     -8.5955e-02    7.0248e+01  13644      0      0    0 FALSE  TRUE 0.982
## END : ex_powell
##
## next
## Problem: penalty_1
## about to call opm

## Warning in opm(x0, tfn, tgr, hess = the, lower = lo, upper = up, method =
## ameth, : Duplicate methods requested by user removed

## Warning in opm(x0, tfn, tgr, hess = the, lower = lo, upper = up, method =
## ameth, : 'snewtonm' removed from 'method' -- no hess()

## Warning in opm(x0, tfn, tgr, hess = the, lower = lo, upper = up, method =
## ameth, : 'snewtm' removed from 'method' -- no hess()

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing
```

```
## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing
##              p1 s1      p2 s2  p3 s3     p4 s4      p5 s5  value fevals gevals
## L-BFGS-B 0.9000  L 0.90000  L 0.9  L 0.9000  L 0.90000  L 61.623      2      2
## nlminb   0.9000  L 0.90000  L 0.9  L 0.9000  L 0.90000  L 61.623      9      7
## Rcgmin   0.9000  L 0.90000  L 0.9  L 0.9000  L 0.90000  L 61.623     23     22
## Rtnmin   0.9000  L 0.90000  L 0.9  L 0.9000  L 0.90000  L 61.623     33     33
## bobyqa   0.9000  L 0.90000  L 0.9  L 0.9000  L 0.90000  L 61.623    177      0
## nmkb     0.9000  L 0.90000  L 0.9  L 0.9000  L 0.90000  L 61.623     90      0
## hjn      0.9000  L 0.90000  L 0.9  L 0.9000  L 0.90000  L 61.623    230      0
## ncg      0.9000  L 0.90000  L 0.9  L 0.9000  L 0.90000  L 61.623     23     22
## slsqp    0.9000  L 0.90000  L 0.9  L 0.9000  L 0.90000  L 61.623      6      5
## tnewt    0.9000  L 0.90000  L 0.9  L 0.9000  L 0.90000  L 61.623     13     12
## spg      0.9000  L 0.90000  L 0.9  L 0.9000  L 0.90000    61.623     84      3
## lbfgsb3  0.9000  L 0.90000  L 0.9  L 0.9000  L 0.90000  L 61.623      2      2
## nvm      0.9000  L 0.90000    0.9  L 0.9000  L 0.90000  L 61.623     45     43
## Rvmmin   0.9000  L 0.90000    0.9  L 0.9000  L 0.90000  L 61.623     45     43
## hjkb     0.9000    0.90000  L 0.9  L 0.9000  L 0.90000  L 61.623    469      0
## nlnm     1.2961    0.93213    0.9  L 0.9518    0.92423    89.912  15002      0
##          hevals conv  kkt1 kkt2 xtime
## L-BFGS-B      0    0 FALSE TRUE 0.002
## nlminb        0    0 FALSE TRUE 0.002
## Rcgmin        0    0 FALSE TRUE 0.002
## Rtnmin        0    0 FALSE TRUE 0.000
## bobyqa        0    0 FALSE TRUE 0.003
## nmkb          0    0 FALSE TRUE 0.010
```

```
## hjn           0    0 FALSE TRUE 0.004
## ncg           0    0 FALSE TRUE 0.002
## slsqp         0    0 FALSE TRUE 0.003
## tnewt         0    0 FALSE TRUE 0.003
## spg           0    0 FALSE TRUE 0.001
## lbfgsb3       0    0 FALSE TRUE 0.002
## nvm           0    2 FALSE TRUE 0.003
## Rvmmin        0    2 FALSE TRUE 0.008
## hjkb          0    0 FALSE TRUE 0.009
## nlnm          0    0 FALSE TRUE 0.096
## END : penalty_1
##
## next
## Problem: penalty_2
## about to call opm

## Warning in opm(x0, tfn, tgr, hess = the, lower = lo, upper = up, method =
## ameth, : Duplicate methods requested by user removed

## Warning in opm(x0, tfn, tgr, hess = the, lower = lo, upper = up, method =
## ameth, : 'snewtonm' removed from 'method' -- no hess()

## Warning in opm(x0, tfn, tgr, hess = the, lower = lo, upper = up, method =
## ameth, : 'snewtm' removed from 'method' -- no hess()

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in minqa::bobyqa(par = spar, fn = efn, lower = slower, upper = supper,
## : All upper - lower must be >= 2*rhobeg. Changing rhobeg

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing
```

```
## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing
##           p1 s1  p2 s2  p3 s3  p4 s4  p5 s5  value fevals gevals hevals conv
## L-BFGS-B 0.4  L 0.4  L 0.4  L 0.4  L 0.4  L 60.880      2      2      0    0
## nlminb   0.4  L 0.4  L 0.4  L 0.4  L 0.4  L 60.880      3      2      0    0
## Rcgmin   0.4  L 0.4  L 0.4  L 0.4  L 0.4  L 60.880     21     20      0    0
## Rtnmin   0.4  L 0.4  L 0.4  L 0.4  L 0.4  L 60.880     30     30      0    0
## bobyqa   0.4  L 0.4  L 0.4  L 0.4  L 0.4  L 60.880     42      0      0    0
## hjkb     0.4  L 0.4  L 0.4  L 0.4  L 0.4  L 60.880    253      0      0    0
## hjn      0.4  L 0.4  L 0.4  L 0.4  L 0.4  L 60.880    131      0      0    0
## ncg      0.4  L 0.4  L 0.4  L 0.4  L 0.4  L 60.880     21     20      0    0
## slsqp    0.4  L 0.4  L 0.4  L 0.4  L 0.4  L 60.880      4      3      0    0
## tnewt    0.4  L 0.4  L 0.4  L 0.4  L 0.4  L 60.880     13     12      0    0
## spg      0.4  L 0.4  L 0.4  L 0.4  L 0.4  L 60.880     84      3      0    0
## lbfgsb3  0.4  L 0.4  L 0.4  L 0.4  L 0.4  L 60.880      2      2      0    0
## nvm      0.4  L 0.4    0.4  L 0.4  L 0.4    60.880     41     41      0    0
## Rvmmin   0.4  L 0.4    0.4  L 0.4  L 0.4    60.880     41     41      0    0
## nlnm     0.4  L 0.4    0.4    0.4    0.4    64.041   7181      0      0    0
## nmkb     0.4  L 0.4  L 0.4  L 0.4  L 0.4  L 67.280    107      0      0    0
##           kkt1 kkt2 xtime
## L-BFGS-B FALSE TRUE 0.001
## nlminb   FALSE TRUE 0.001
## Rcgmin   FALSE TRUE 0.003
## Rtnmin   FALSE TRUE 0.006
## bobyqa   FALSE TRUE 0.002
## hjkb     FALSE TRUE 0.002
## hjn      FALSE TRUE 0.000
## ncg      FALSE TRUE 0.000
## slsqp    FALSE TRUE 0.003
## tnewt    FALSE TRUE 0.004
## spg      FALSE TRUE 0.001
## lbfgsb3  FALSE TRUE 0.002
## nvm      FALSE TRUE 0.009
## Rvmmin   FALSE TRUE 0.008
## nlnm     FALSE TRUE 0.086
## nmkb     FALSE TRUE 0.009
## END : penalty_2
```

```
##
## next
## Problem: var_dim
## about to call opm
## Warning in opm(x0, tfn, tgr, hess = the, lower = lo, upper = up, method =
## ameth, : Duplicate methods requested by user removed
## Warning in opm(x0, tfn, tgr, hess = the, lower = lo, upper = up, method =
## ameth, : 'snewtonm' removed from 'method' -- no hess()
## Warning in opm(x0, tfn, tgr, hess = the, lower = lo, upper = up, method =
## ameth, : 'snewtm' removed from 'method' -- no hess()
## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing
## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing
## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing
## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing
## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing
## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing
## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing
## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing
## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing
## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing
## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing
## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing
## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing
## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing
```

```
## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

##              p1 s1      p2 s2      p3 s3      p4 s4      p5 s5  value fevals
## nmkb     0.93333  U 0.93333  U 0.93333  U 0.93333  U 0.93333  U 5.8283     42
## L-BFGS-B 0.93333  U 0.93333  U 0.93333  U 0.93333  U 0.93333  U 5.8283      2
## nlminb   0.93333  U 0.93333  U 0.93333  U 0.93333  U 0.93333  U 5.8283      6
## Rcgmin   0.93333  U 0.93333  U 0.93333  U 0.93333  U 0.93333  U 5.8283     13
## Rtnmin   0.93333  U 0.93333  U 0.93333  U 0.93333  U 0.93333  U 5.8283     19
## nvm      0.93333  U 0.93333  U 0.93333  U 0.93333  U 0.93333  U 5.8283     33
## Rvmmin   0.93333  U 0.93333  U 0.93333  U 0.93333  U 0.93333  U 5.8283     33
## bobyqa   0.93333  U 0.93333  U 0.93333  U 0.93333  U 0.93333  U 5.8283    186
## hjn      0.93333  U 0.93333  U 0.93333  U 0.93333  U 0.93333  U 5.8283     73
## ncg      0.93333  U 0.93333  U 0.93333  U 0.93333  U 0.93333  U 5.8283     13
## slsqp    0.93333  U 0.93333  U 0.93333  U 0.93333  U 0.93333  U 5.8283      8
## tnewt    0.93333  U 0.93333  U 0.93333  U 0.93333  U 0.93333  U 5.8283      9
## spg      0.93333  U 0.93333  U 0.93333  U 0.93333  U 0.93333  U 5.8283     52
## lbfgsb3  0.93333  U 0.93333  U 0.93333  U 0.93333  U 0.93333  U 5.8283      2
## hjkb     0.93333    0.93333    0.93333  U 0.93333  U 0.93333  U 5.8283    306
## nlnm     0.93333  U 0.93333    0.93333  U 0.93333    0.93333  U 5.8284    143
##          gevals hevals conv  kkt1 kkt2 xtime
## nmkb          0      0    0 FALSE TRUE 0.003
## L-BFGS-B      2      0    0 FALSE TRUE 0.001
## nlminb        5      0    0 FALSE TRUE 0.001
## Rcgmin       12      0    0 FALSE TRUE 0.001
## Rtnmin       19      0    0 FALSE TRUE 0.004
## nvm          33      0    2 FALSE TRUE 0.003
## Rvmmin       33      0    2 FALSE TRUE 0.002
## bobyqa        0      0    0 FALSE TRUE 0.002
## hjn           0      0    0 FALSE TRUE 0.001
## ncg          12      0    0 FALSE TRUE 0.001
## slsqp         7      0    0 FALSE TRUE 0.002
## tnewt         8      0    0 FALSE TRUE 0.000
## spg           3      0    0 FALSE TRUE 0.001
## lbfgsb3       2      0    0 FALSE TRUE 0.001
## hjkb          0      0    0 FALSE TRUE 0.002
## nlnm          0      0    0 FALSE TRUE 0.001
## END : var_dim
##
## next
## Problem: trigon
## about to call opm

## Warning in opm(x0, tfn, tgr, hess = the, lower = lo, upper = up, method =
## ameth, : Duplicate methods requested by user removed

## Warning in opm(x0, tfn, tgr, hess = the, lower = lo, upper = up, method =
## ameth, : 'snewtonm' removed from 'method' -- no hess()

## Warning in opm(x0, tfn, tgr, hess = the, lower = lo, upper = up, method =
## ameth, : 'snewtm' removed from 'method' -- no hess()

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
```

```
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing
##               p1 s1       p2 s2       p3 s3       p4 s4       p5 s5      value
## nvm      0.068136    0.070864    0.074119    0.078144    0.083403    5.5753e-05
## Rvmmin   0.068136    0.070864    0.074119    0.078144    0.083403    5.5753e-05
## tnewt    0.068136    0.070864    0.074119    0.078144    0.083403    5.5753e-05
## nlminb   0.068136    0.070864    0.074119    0.078144    0.083403    5.5753e-05
## slsqp    0.068136    0.070864    0.074119    0.078144    0.083403    5.5753e-05
## bobyqa   0.068136    0.070864    0.074119    0.078144    0.083403    5.5753e-05
```

```
## Rtnmin   0.068136    0.070864    0.074119    0.078144    0.083403    5.5753e-05
## nlnm     0.068136    0.070864    0.074119    0.078144    0.083403    5.5753e-05
## ncg      0.068136    0.070864    0.074120    0.078144    0.083404    5.5753e-05
## Rcgmin   0.068136    0.070864    0.074119    0.078144    0.083403    5.5753e-05
## hjkb     0.068138    0.070866    0.074120    0.078144    0.083405    5.5753e-05
## spg      0.068137    0.070864    0.074125    0.078142    0.083404    5.5753e-05
## lbfgsb3  0.068141    0.070869    0.074119    0.078151    0.083412    5.5753e-05
## L-BFGS-B 0.068133    0.070862    0.074146    0.078145    0.083407    5.5754e-05
## nmkb     0.067607    0.070039    0.073801    0.078749    0.082447    6.4719e-05
## hjn      0.080749    0.084641    0.089466    0.095773    0.225000  U 6.6075e-04
##          fevals gevals hevals conv  kkt1  kkt2 xtime
## nvm          30     26      0    0 FALSE  TRUE 0.001
## Rvmmin       30     26      0    0 FALSE  TRUE 0.003
## tnewt        45     44      0    0 FALSE  TRUE 0.003
## nlminb       24     22      0    0 FALSE  TRUE 0.000
## slsqp        24     23      0    0 FALSE  TRUE 0.002
## bobyqa      297      0      0    0 FALSE  TRUE 0.002
## Rtnmin       42     42      0    0 FALSE  TRUE 0.003
## nlnm       5132      0      0    0 FALSE  TRUE 0.028
## ncg          51     25      0    0 FALSE  TRUE 0.000
## Rcgmin       51     25      0    0 FALSE  TRUE 0.002
## hjkb        883      0      0    0 FALSE  TRUE 0.006
## spg         102     36      0    0 FALSE  TRUE 0.003
## lbfgsb3      20     20      0    0 FALSE  TRUE 0.003
## L-BFGS-B     21     21      0    0 FALSE  TRUE 0.000
## nmkb        322      0      0    0 FALSE  TRUE 0.017
## hjn         978      0      0    0 FALSE FALSE 0.008
## END : trigon
##
## next
## Problem: brown_al
## about to call opm

## Warning in opm(x0, tfn, tgr, hess = the, lower = lo, upper = up, method =
## ameth, : Duplicate methods requested by user removed

## Warning in opm(x0, tfn, tgr, hess = the, lower = lo, upper = up, method =
## ameth, : 'snewtonm' removed from 'method' -- no hess()

## Warning in opm(x0, tfn, tgr, hess = the, lower = lo, upper = up, method =
## ameth, : 'snewtm' removed from 'method' -- no hess()

## Warning in minqa::bobyqa(par = spar, fn = efn, lower = slower, upper = supper,
## : All upper - lower must be >= 2*rhobeg. Changing rhobeg

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

##           p1 s1  p2 s2  p3 s3  p4 s4  p5 s5  value fevals gevals hevals conv
## L-BFGS-B 0.6  U 0.6  U 0.6  U 0.6  U 0.6  U 91.687      2      2      0    0
## nlminb   0.6  U 0.6  U 0.6  U 0.6  U 0.6  U 91.687      3      2      0    0
```

```
## Rcgmin   0.6  U 0.6  U 0.6  U 0.6  U 0.6  U 91.687      5      4      0    0
## Rtnmin   0.6  U 0.6  U 0.6  U 0.6  U 0.6  U 91.687      6      6      0    0
## nvm      0.6  U 0.6  U 0.6  U 0.6  U 0.6  U 91.687      4      4      0    2
## Rvmmin   0.6  U 0.6  U 0.6  U 0.6  U 0.6  U 91.687      4      4      0    2
## bobyqa   0.6  U 0.6  U 0.6  U 0.6  U 0.6  U 91.687     34      0      0    0
## nmkb     0.6  U 0.6  U 0.6  U 0.6  U 0.6  U 91.687     63      0      0    0
## hjn      0.6  U 0.6  U 0.6  U 0.6  U 0.6  U 91.687     97      0      0    0
## ncg      0.6  U 0.6  U 0.6  U 0.6  U 0.6  U 91.687      5      4      0    0
## tnewt    0.6  U 0.6  U 0.6  U 0.6  U 0.6  U 91.687      5      4      0    0
## spg      0.6  U 0.6  U 0.6  U 0.6  U 0.6  U 91.687     68      3      0    0
## lbfgsb3  0.6  U 0.6  U 0.6  U 0.6  U 0.6  U 91.687      2      2      0    0
## slsqp    0.6    0.6    0.6    0.6    0.6    91.687      5      4      0    0
## hjkb     0.6  U 0.6  U 0.6  U 0.6    0.6  U 91.687    300      0      0    0
## nlnm     0.6    0.6  U 0.6    0.6    0.6  U 91.687    538      0      0    0
##           kkt1 kkt2 xtime
## L-BFGS-B FALSE TRUE 0.001
## nlminb   FALSE TRUE 0.001
## Rcgmin   FALSE TRUE 0.001
## Rtnmin   FALSE TRUE 0.001
## nvm      FALSE TRUE 0.001
## Rvmmin   FALSE TRUE 0.000
## bobyqa   FALSE TRUE 0.001
## nmkb     FALSE TRUE 0.004
## hjn      FALSE TRUE 0.000
## ncg      FALSE TRUE 0.001
## tnewt    FALSE TRUE 0.002
## spg      FALSE TRUE 0.002
## lbfgsb3  FALSE TRUE 0.001
## slsqp    FALSE TRUE 0.002
## hjkb     FALSE TRUE 0.002
## nlnm     FALSE TRUE 0.007
## END : brown_al
##
## next
## Problem: disc_bv
## about to call opm
## Warning in opm(x0, tfn, tgr, hess = the, lower = lo, upper = up, method =
## ameth, : Duplicate methods requested by user removed
## Warning in opm(x0, tfn, tgr, hess = the, lower = lo, upper = up, method =
## ameth, : 'snewtonm' removed from 'method' -- no hess()
## Warning in opm(x0, tfn, tgr, hess = the, lower = lo, upper = up, method =
## ameth, : 'snewtm' removed from 'method' -- no hess()
## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing
## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing
## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing
## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
```

```
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing
##                p1 s1       p2 s2       p3 s3       p4 s4       p5 s5    value
## nvm      0.094444  L 0.148010    0.170526    0.168885    0.145231    0.040329
## Rvmmin   0.094444  L 0.148010    0.170526    0.168885    0.145231    0.040329
## tnewt    0.094444  L 0.148010    0.170526    0.168885    0.145231    0.040329
## nlminb   0.094444  L 0.148010    0.170526    0.168885    0.145231    0.040329
## Rcgmin   0.094444  L 0.148010    0.170526    0.168885    0.145231    0.040329
## slsqp    0.094444    0.148010    0.170526    0.168885    0.145231    0.040329
## ncg      0.094444  L 0.148010    0.170526    0.168885    0.145231    0.040329
## hjn      0.094444  L 0.148010    0.170526    0.168885    0.145231    0.040329
## Rtnmin   0.094444  L 0.148009    0.170525    0.168885    0.145231    0.040329
## nlnm     0.094444    0.148009    0.170525    0.168885    0.145231    0.040329
## bobyqa   0.094444  L 0.148011    0.170527    0.168886    0.145231    0.040329
## lbfgsb3  0.094444  L 0.148010    0.170526    0.168886    0.145231    0.040329
## hjkb     0.094444  L 0.148012    0.170528    0.168889    0.145232    0.040329
## L-BFGS-B 0.094444  L 0.148008    0.170522    0.168885    0.145232    0.040329
## spg      0.094444  L 0.148023    0.170546    0.168909    0.145242    0.040329
```

```
## nmkb     0.094444  L 0.094444  L 0.094444    0.094444    0.094444  L 0.049834
##          fevals gevals hevals conv  kkt1 kkt2 xtime
## nvm          33     22      0    2 FALSE TRUE 0.003
## Rvmmin       33     22      0    2 FALSE TRUE 0.005
## tnewt        37     36      0    0 FALSE TRUE 0.001
## nlminb       19     17      0    0 FALSE TRUE 0.000
## Rcgmin       63     32      0    0 FALSE TRUE 0.002
## slsqp        26     25      0    0 FALSE TRUE 0.002
## ncg          64     33      0    0 FALSE TRUE 0.001
## hjn         926      0      0    0 FALSE TRUE 0.009
## Rtnmin       93     93      0    0 FALSE TRUE 0.004
## nlnm        726      0      0    0 FALSE TRUE 0.005
## bobyqa      282      0      0    0 FALSE TRUE 0.004
## lbfgsb3      21     21      0    0 FALSE TRUE 0.002
## hjkb        928      0      0    0 FALSE TRUE 0.008
## L-BFGS-B     23     23      0    0 FALSE TRUE 0.000
## spg         129     78      0    0 FALSE TRUE 0.007
## nmkb        176      0      0    0 FALSE TRUE 0.017
## END : disc_bv
##
## next
## Problem: disc_ie
## about to call opm

## Warning in opm(x0, tfn, tgr, hess = the, lower = lo, upper = up, method =
## ameth, : Duplicate methods requested by user removed

## Warning in opm(x0, tfn, tgr, hess = the, lower = lo, upper = up, method =
## ameth, : 'snewtonm' removed from 'method' -- no hess()

## Warning in opm(x0, tfn, tgr, hess = the, lower = lo, upper = up, method =
## ameth, : 'snewtm' removed from 'method' -- no hess()

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing
```

```
## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing
##                p1 s1       p2 s2       p3 s3       p4 s4       p5 s5  value
## spg      0.040625  L 0.040625    0.040625    0.040625    0.040625    0.4141
## L-BFGS-B 0.040625  L 0.040625  L 0.040625  L 0.040625  L 0.040625  L 0.4141
## nlminb   0.040625  L 0.040625  L 0.040625  L 0.040625  L 0.040625  L 0.4141
## Rtnmin   0.040625  L 0.040625  L 0.040625  L 0.040625    0.040625  L 0.4141
## nvm      0.040625  L 0.040625  L 0.040625  L 0.040625  L 0.040625  L 0.4141
## Rvmmin   0.040625  L 0.040625  L 0.040625  L 0.040625  L 0.040625  L 0.4141
## bobyqa   0.040625  L 0.040625  L 0.040625  L 0.040625  L 0.040625  L 0.4141
## hjn      0.040625  L 0.040625  L 0.040625  L 0.040625  L 0.040625  L 0.4141
## tnewt    0.040625  L 0.040625  L 0.040625  L 0.040625  L 0.040625  L 0.4141
## lbfgsb3  0.040625  L 0.040625  L 0.040625  L 0.040625  L 0.040625  L 0.4141
## Rcgmin   0.040625  L 0.040625  L 0.040625  L 0.040625  L 0.040625  L 0.4141
## hjkb     0.040625  L 0.040625  L 0.040625  L 0.040625  L 0.040625  L 0.4141
## ncg      0.040625  L 0.040625  L 0.040625  L 0.040625  L 0.040625  L 0.4141
## slsqp    0.040625  L 0.040625    0.040625    0.040625    0.040625    0.4141
## nlnm     0.040625    0.040625  L 0.040625  L 0.040625  L 0.040625    0.4141
## nmkb     0.040625  L 0.040625    0.040625  L 0.040625  L 0.040625  L 7.5373
##          fevals gevals hevals conv  kkt1 kkt2 xtime
## spg          68      3      0    0 FALSE TRUE 0.002
## L-BFGS-B      2      2      0    0 FALSE TRUE 0.001
## nlminb        5      3      0    0 FALSE TRUE 0.001
## Rtnmin       24     24      0    0 FALSE TRUE 0.005
## nvm          29     29      0    2 FALSE TRUE 0.003
## Rvmmin       29     29      0    2 FALSE TRUE 0.003
## bobyqa       44      0      0    0 FALSE TRUE 0.000
## hjn         131      0      0    0 FALSE TRUE 0.002
## tnewt        11     10      0    0 FALSE TRUE 0.000
## lbfgsb3       2      2      0    0 FALSE TRUE 0.001
## Rcgmin       17     16      0    0 FALSE TRUE 0.002
```

```
## hjkb        369      0      0    0 FALSE TRUE 0.003
## ncg          17     16      0    0 FALSE TRUE 0.001
## slsqp         4      3      0    0 FALSE TRUE 0.002
## nlnm       7149      0      0    0 FALSE TRUE 0.057
## nmkb         75      0      0    0 FALSE TRUE 0.005
## END : disc_ie
##
## next
## Problem: broyden_tri
## about to call opm

## Warning in opm(x0, tfn, tgr, hess = the, lower = lo, upper = up, method =
## ameth, : Duplicate methods requested by user removed

## Warning in opm(x0, tfn, tgr, hess = the, lower = lo, upper = up, method =
## ameth, : 'snewtonm' removed from 'method' -- no hess()

## Warning in opm(x0, tfn, tgr, hess = the, lower = lo, upper = up, method =
## ameth, : 'snewtm' removed from 'method' -- no hess()

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in minqa::bobyqa(par = spar, fn = efn, lower = slower, upper = supper,
## : All upper - lower must be >= 2*rhobeg. Changing rhobeg

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
```

```
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing
```

	p1	s1	p2	s2	p3	s3	p4	s4	p5	s5	value	fevals	gevals	hevals
L-BFGS-B	-0.9	U	-0.9	U	-0.9	U	-0.9	U	-0.9	U	10.473	2	2	0
nlminb	-0.9	U	-0.9	U	-0.9	U	-0.9	U	-0.9	U	10.473	4	2	0
Rcgmin	-0.9	U	-0.9	U	-0.9	U	-0.9	U	-0.9	U	10.473	17	16	0
Rtnmin	-0.9	U	-0.9	U	-0.9	U	-0.9	U	-0.9	U	10.473	27	27	0
nvm	-0.9	U	-0.9	U	-0.9	U	-0.9	U	-0.9	U	10.473	24	24	0
Rvmmin	-0.9	U	-0.9	U	-0.9	U	-0.9	U	-0.9	U	10.473	24	24	0
bobyqa	-0.9	U	-0.9	U	-0.9	U	-0.9	U	-0.9	U	10.473	37	0	0
nmkb	-0.9	U	-0.9	U	-0.9	U	-0.9	U	-0.9	U	10.473	60	0	0
hjkb	-0.9	U	-0.9	U	-0.9	U	-0.9	U	-0.9	U	10.473	224	0	0
hjn	-0.9	U	-0.9	U	-0.9	U	-0.9	U	-0.9	U	10.473	97	0	0
ncg	-0.9	U	-0.9	U	-0.9	U	-0.9	U	-0.9	U	10.473	17	16	0
tnewt	-0.9	U	-0.9	U	-0.9	U	-0.9	U	-0.9	U	10.473	11	10	0
spg	-0.9	U	-0.9	U	-0.9	U	-0.9	U	-0.9	U	10.473	68	3	0
lbfgsb3	-0.9	U	-0.9	U	-0.9	U	-0.9	U	-0.9	U	10.473	2	2	0
slsqp	-0.9	U	-0.9		-0.9		-0.9		-0.9		10.473	5	4	0
nlnm	-0.9		-0.9		-0.9		-0.9		-0.9		10.473	2443	0	0

	conv	kkt1	kkt2	xtime
L-BFGS-B	0	FALSE	TRUE	0.001
nlminb	0	FALSE	TRUE	0.000
Rcgmin	0	FALSE	TRUE	0.001
Rtnmin	0	FALSE	TRUE	0.003
nvm	2	FALSE	TRUE	0.001
Rvmmin	2	FALSE	TRUE	0.002
bobyqa	0	FALSE	TRUE	0.001
nmkb	0	FALSE	TRUE	0.003
hjkb	0	FALSE	TRUE	0.001
hjn	0	FALSE	TRUE	0.001
ncg	0	FALSE	TRUE	0.002
tnewt	0	FALSE	TRUE	0.002
spg	0	FALSE	TRUE	0.002
lbfgsb3	0	FALSE	TRUE	0.001
slsqp	0	FALSE	TRUE	0.000
nlnm	0	FALSE	TRUE	0.023

```
## END : broyden_tri
##
## next
## Problem: broyden_band
## about to call opm

## Warning in opm(x0, tfn, tgr, hess = the, lower = lo, upper = up, method =
```

```
## ameth, : Duplicate methods requested by user removed

## Warning in opm(x0, tfn, tgr, hess = the, lower = lo, upper = up, method =
## ameth, : 'snewtonm' removed from 'method' -- no hess()

## Warning in opm(x0, tfn, tgr, hess = the, lower = lo, upper = up, method =
## ameth, : 'snewtm' removed from 'method' -- no hess()

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in minqa::bobyqa(par = spar, fn = efn, lower = slower, upper = supper,
## : All upper - lower must be >= 2*rhobeg. Changing rhobeg

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing
```

```
## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing
```

```
##            p1 s1   p2 s2   p3 s3   p4 s4   p5 s5  value fevals gevals hevals
## L-BFGS-B -0.9  U -0.9  U -0.9  U -0.9  U -0.9  U 133.69      2      2      0
## nlminb   -0.9  U -0.9  U -0.9  U -0.9  U -0.9  U 133.69      4      2      0
## Rcgmin   -0.9  U -0.9  U -0.9  U -0.9  U -0.9  U 133.69     15     14      0
## Rtnmin   -0.9  U -0.9  U -0.9  U -0.9  U -0.9  U 133.69     24     24      0
## bobyqa   -0.9  U -0.9  U -0.9  U -0.9  U -0.9  U 133.69     31      0      0
## nmkb     -0.9  U -0.9  U -0.9  U -0.9  U -0.9  U 133.69     63      0      0
## hjn      -0.9  U -0.9  U -0.9  U -0.9  U -0.9  U 133.69     97      0      0
## ncg      -0.9  U -0.9  U -0.9  U -0.9  U -0.9  U 133.69     15     14      0
## slsqp    -0.9  U -0.9  U -0.9  U -0.9  U -0.9  U 133.69      4      3      0
## tnewt    -0.9  U -0.9  U -0.9  U -0.9  U -0.9  U 133.69     10      9      0
## spg      -0.9  U -0.9  U -0.9  U -0.9  U -0.9  U 133.69     68      3      0
## lbfgsb3  -0.9  U -0.9  U -0.9  U -0.9  U -0.9  U 133.69      2      2      0
## nvm      -0.9    -0.9    -0.9  U -0.9    -0.9    133.69     26     26      0
## Rvmmin   -0.9    -0.9    -0.9  U -0.9    -0.9    133.69     26     26      0
## hjkb     -0.9  U -0.9    -0.9  U -0.9  U -0.9  U 133.69    300      0      0
## nlnm     -0.9    -0.9    -0.9    -0.9    -0.9    133.69    283      0      0
##          conv  kkt1 kkt2 xtime
## L-BFGS-B    0 FALSE TRUE 0.001
## nlminb      0 FALSE TRUE 0.001
## Rcgmin      0 FALSE TRUE 0.000
## Rtnmin      0 FALSE TRUE 0.002
## bobyqa      0 FALSE TRUE 0.001
## nmkb        0 FALSE TRUE 0.005
## hjn         0 FALSE TRUE 0.002
## ncg         0 FALSE TRUE 0.000
## slsqp       0 FALSE TRUE 0.003
## tnewt       0 FALSE TRUE 0.004
## spg         0 FALSE TRUE 0.003
## lbfgsb3     0 FALSE TRUE 0.002
## nvm         0 FALSE TRUE 0.005
## Rvmmin      0 FALSE TRUE 0.003
## hjkb        0 FALSE TRUE 0.006
## nlnm        0 FALSE TRUE 0.015
## END : broyden_band
##
## next
## Problem: linfun_fr
## about to call opm
```

```
## Warning in opm(x0, tfn, tgr, hess = the, lower = lo, upper = up, method =
## ameth, : Duplicate methods requested by user removed
```

```
## Warning in opm(x0, tfn, tgr, hess = the, lower = lo, upper = up, method =
## ameth, : 'snewtonm' removed from 'method' -- no hess()
```

```
## Warning in opm(x0, tfn, tgr, hess = the, lower = lo, upper = up, method =
## ameth, : 'snewtm' removed from 'method' -- no hess()
```

```
## Warning in minqa::bobyqa(par = spar, fn = efn, lower = slower, upper = supper,
## : All upper - lower must be >= 2*rhobeg. Changing rhobeg
```

```
## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing
```

```
## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing
```

```
##           p1 s1  p2 s2  p3 s3  p4 s4  p5 s5  value fevals gevals hevals conv
## L-BFGS-B 0.9  L 0.9  L 0.9  L 0.9  L 0.9  L 120.88      2      2      0    0
## nlminb   0.9  L 0.9  L 0.9  L 0.9  L 0.9  L 120.88      3      2      0    0
## Rcgmin   0.9  L 0.9  L 0.9  L 0.9  L 0.9  L 120.88      3      2      0    0
## Rtnmin   0.9  L 0.9  L 0.9  L 0.9  L 0.9  L 120.88      3      3      0    0
## nvm      0.9  L 0.9  L 0.9  L 0.9  L 0.9  L 120.88      2      2      0    2
## Rvmmin   0.9  L 0.9  L 0.9  L 0.9  L 0.9  L 120.88      2      2      0    2
## bobyqa   0.9  L 0.9  L 0.9  L 0.9  L 0.9  L 120.88     31      0      0    0
## nmkb     0.9  L 0.9  L 0.9  L 0.9    0.9  L 120.88     74      0      0    0
## hjn      0.9  L 0.9  L 0.9  L 0.9  L 0.9  L 120.88    105      0      0    0
## ncg      0.9  L 0.9  L 0.9  L 0.9  L 0.9  L 120.88      3      2      0    0
## slsqp    0.9  L 0.9  L 0.9  L 0.9  L 0.9  L 120.88      4      3      0    0
## tnewt    0.9  L 0.9  L 0.9  L 0.9  L 0.9  L 120.88      4      3      0    0
## spg      0.9  L 0.9  L 0.9  L 0.9  L 0.9  L 120.88     68      3      0    0
## lbfgsb3  0.9  L 0.9  L 0.9  L 0.9  L 0.9  L 120.88      2      2      0    0
## hjkb     0.9  L 0.9  L 0.9  L 0.9  L 0.9  L 120.88    300      0      0    0
## nlnm     0.9    0.9    0.9    0.9    0.9    120.88   4291      0      0    0
##           kkt1 kkt2 xtime
## L-BFGS-B FALSE TRUE 0.000
## nlminb   FALSE TRUE 0.000
## Rcgmin   FALSE TRUE 0.001
## Rtnmin   FALSE TRUE 0.001
## nvm      FALSE TRUE 0.001
## Rvmmin   FALSE TRUE 0.001
## bobyqa   FALSE TRUE 0.001
## nmkb     FALSE TRUE 0.007
## hjn      FALSE TRUE 0.001
## ncg      FALSE TRUE 0.001
## slsqp    FALSE TRUE 0.000
## tnewt    FALSE TRUE 0.002
## spg      FALSE TRUE 0.001
## lbfgsb3  FALSE TRUE 0.001
## hjkb     FALSE TRUE 0.004
## nlnm     FALSE TRUE 0.023
## END : linfun_fr
##
## next
## Problem: linfun_r1
## about to call opm
```

```
## Warning in opm(x0, tfn, tgr, hess = the, lower = lo, upper = up, method =
## ameth, : Duplicate methods requested by user removed
```

```
## Warning in opm(x0, tfn, tgr, hess = the, lower = lo, upper = up, method =
## ameth, : 'snewtonm' removed from 'method' -- no hess()
```

```
## Warning in opm(x0, tfn, tgr, hess = the, lower = lo, upper = up, method =
## ameth, : 'snewtm' removed from 'method' -- no hess()
```

```
## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing
```

```
## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing
## Warning in minqa::bobyqa(par = spar, fn = efn, lower = slower, upper = supper,
## : All upper - lower must be >= 2*rhobeg. Changing rhobeg
## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing
##           p1 s1      p2 s2      p3 s3      p4 s4  p5 s5     value fevals gevals
## L-BFGS-B 0.9  L 0.90000  L 0.90000  L 0.90000  L 0.9  L 354859156      2      2
## nlminb   0.9  L 0.90000  L 0.90000  L 0.90000  L 0.9  L 354859156      3      2
## Rcgmin   0.9  L 0.90000  L 0.90000  L 0.90000  L 0.9  L 354859156     17     16
## Rtnmin   0.9  L 0.90000  L 0.90000  L 0.90000  L 0.9  L 354859156     17     17
## bobyqa   0.9  L 0.90000  L 0.90000  L 0.90000  L 0.9  L 354859156     32      0
## nmkb     0.9    0.90000  L 0.90000    0.90000  L 0.9  L 354859156    148      0
## hjkb     0.9  L 0.90000  L 0.90000  L 0.90000  L 0.9  L 354859156    207      0
## hjn      0.9  L 0.90000  L 0.90000  L 0.90000  L 0.9  L 354859156    105      0
## ncg      0.9  L 0.90000  L 0.90000  L 0.90000  L 0.9  L 354859156     17     16
```

```
## tnewt    0.9  L 0.90000  L 0.90000  L 0.90000  L 0.9  L 354859156     11     10
## spg      0.9  L 0.90000  L 0.90000  L 0.90000  L 0.9  L 354859156     68      3
## lbfgsb3  0.9  L 0.90000  L 0.90000  L 0.90000  L 0.9  L 354859156      2      2
## nlnm     0.9    0.90000    0.90000    0.90000    0.9    354859552   4045      0
## nvm      0.9  L 0.90012    0.90003    0.90001    0.9    354867677     16     16
## Rvmmin   0.9  L 0.90012    0.90003    0.90001    0.9    354867677     16     16
## slsqp    1.0    1.00000    1.00000    1.00000    1.0    438138100      3      2
##          hevals conv  kkt1  kkt2 xtime
## L-BFGS-B      0    0 FALSE FALSE 0.001
## nlminb        0    0 FALSE FALSE 0.000
## Rcgmin        0    0 FALSE FALSE 0.001
## Rtnmin        0    0 FALSE FALSE 0.001
## bobyqa        0    0 FALSE FALSE 0.001
## nmkb          0    0 FALSE FALSE 0.009
## hjkb          0    0 FALSE FALSE 0.001
## hjn           0    0 FALSE FALSE 0.002
## ncg           0    0 FALSE FALSE 0.001
## tnewt         0    0 FALSE FALSE 0.002
## spg           0    0 FALSE FALSE 0.001
## lbfgsb3       0    0 FALSE FALSE 0.001
## nlnm          0    0 FALSE FALSE 0.026
## nvm           0    0 FALSE FALSE 0.002
## Rvmmin        0    0 FALSE FALSE 0.000
## slsqp         0 9999    NA    NA 0.002
## END : linfun_r1
##
## next
## Problem: linfun_r1z
## about to call opm

## Warning in opm(x0, tfn, tgr, hess = the, lower = lo, upper = up, method =
## ameth, : Duplicate methods requested by user removed

## Warning in opm(x0, tfn, tgr, hess = the, lower = lo, upper = up, method =
## ameth, : 'snewtonm' removed from 'method' -- no hess()

## Warning in opm(x0, tfn, tgr, hess = the, lower = lo, upper = up, method =
## ameth, : 'snewtm' removed from 'method' -- no hess()

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing
```

```
## Warning in minqa::bobyqa(par = spar, fn = efn, lower = slower, upper = supper,
## : All upper - lower must be >= 2*rhobeg. Changing rhobeg

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing
##               p1 s1  p2 s2      p3 s3      p4 s4  p5 s5     value fevals gevals
## L-BFGS-B 1.00000    0.9  L 0.90000  L 0.90000  L 0.9  L 187864340      2      2
## nlminb   1.00000    0.9  L 0.90000  L 0.90000  L 0.9  L 187864340      3      2
## Rcgmin   1.00000    0.9  L 0.90000  L 0.90000  L 0.9  L 187864340     13     12
## Rtnmin   1.00000    0.9  L 0.90000  L 0.90000  L 0.9  L 187864340     13     13
## bobyqa   1.00000    0.9    0.90000    0.90000    0.9    187864340     68      0
## nmkb     1.10000  U 0.9  L 0.90000  L 0.90000  L 0.9    187864340     76      0
## hjkb     0.93750    0.9  L 0.90000  L 0.90000  L 0.9  L 187864340    204      0
## hjn      1.00000    0.9  L 0.90000  L 0.90000  L 0.9  L 187864340    127      0
## ncg      1.00000    0.9  L 0.90000  L 0.90000  L 0.9  L 187864340     13     12
## tnewt    1.00000    0.9  L 0.90000  L 0.90000  L 0.9  L 187864340      9      8
## spg      1.00000    0.9  L 0.90000  L 0.90000  L 0.9  L 187864340     56      3
## lbfgsb3  1.00000    0.9  L 0.90000  L 0.90000  L 0.9  L 187864340      2      2
## nlnm     0.90009    0.9    0.90000    0.90000    0.9    187864340   3405      0
## nvm      1.00000    0.9  L 0.90005    0.90002    0.9    187868167     12     12
## Rvmmin   1.00000    0.9  L 0.90005    0.90002    0.9    187868167     12     12
## slsqp    1.00000    1.0    1.00000    1.00000    1.0    231960367      3      2
##          hevals conv  kkt1  kkt2 xtime
## L-BFGS-B      0    0 FALSE FALSE 0.001
## nlminb        0    0 FALSE FALSE 0.000
## Rcgmin        0    0 FALSE FALSE 0.001
## Rtnmin        0    0 FALSE FALSE 0.002
## bobyqa        0    3 FALSE FALSE 0.002
## nmkb          0    0 FALSE FALSE 0.004
## hjkb          0    0 FALSE FALSE 0.001
```

```
## hjn           0    0 FALSE FALSE 0.000
## ncg           0    0 FALSE FALSE 0.002
## tnewt         0    0 FALSE FALSE 0.001
## spg           0    0 FALSE FALSE 0.001
## lbfgsb3       0    0 FALSE FALSE 0.001
## nlnm          0    0 FALSE FALSE 0.021
## nvm           0    0 FALSE FALSE 0.002
## Rvmmin        0    0 FALSE FALSE 0.001
## slsqp         0 9999    NA    NA 0.002
## END : linfun_r1z
##
## next
## Problem: chebyquad
## about to call opm

## Warning in opm(x0, tfn, tgr, hess = the, lower = lo, upper = up, method =
## ameth, : Duplicate methods requested by user removed

## Warning in opm(x0, tfn, tgr, hess = the, lower = lo, upper = up, method =
## ameth, : 'snewtonm' removed from 'method' -- no hess()

## Warning in opm(x0, tfn, tgr, hess = the, lower = lo, upper = up, method =
## ameth, : 'snewtm' removed from 'method' -- no hess()

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing
```

```
## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing

## Warning in kktchk(ans$par, fn, wgr, hess = NULL, upper = NULL, lower = NULL, :
## kktchk: pHes not symmetric -- symmetrizing
##                p1 s1      p2 s2      p3 s3      p4 s4      p5 s5     value
## nvm      0.043153    0.19309    0.26633    0.50000    0.50000    0.0035169
## Rvmmin   0.043153    0.19309    0.26633    0.50000    0.50000    0.0035169
## tnewt    0.043153    0.19309    0.26633    0.50000    0.50000    0.0035169
## nlminb   0.043153    0.19309    0.26633    0.50000    0.50000    0.0035169
## slsqp    0.043153    0.19309    0.26633    0.50000    0.50000    0.0035169
## ncg      0.043153    0.19309    0.26633    0.50000    0.50000    0.0035169
## Rcgmin   0.043153    0.19309    0.26633    0.50000    0.50000    0.0035169
## hjn      0.043153    0.19309    0.26633    0.50000    0.50000    0.0035169
## Rtnmin   0.043153    0.19309    0.26633    0.50000    0.50000    0.0035169
## bobyqa   0.043153    0.19309    0.26633    0.50000    0.50000    0.0035169
## nlnm     0.043153    0.19309    0.26633    0.50000    0.50000    0.0035169
## spg      0.043153    0.19309    0.26633    0.50000    0.50000    0.0035169
## lbfgsb3  0.043151    0.19309    0.26633    0.50000    0.50000    0.0035169
## L-BFGS-B 0.043151    0.19309    0.26633    0.50000    0.50000    0.0035169
## hjkb     0.043152    0.19309    0.26633    0.49999    0.50001    0.0035169
## nmkb     0.042334    0.19133    0.26862    0.49972    0.50062    0.0035502
##          fevals gevals hevals conv  kkt1 kkt2 xtime
## nvm          47     26      0    0  TRUE TRUE 0.003
## Rvmmin       47     26      0    0  TRUE TRUE 0.006
## tnewt       100     99      0    0  TRUE TRUE 0.003
## nlminb       41     28      0    0  TRUE TRUE 0.000
## slsqp        51     50      0    0  TRUE TRUE 0.003
## ncg          84     35      0    0  TRUE TRUE 0.002
## Rcgmin       67     30      0    0  TRUE TRUE 0.005
## hjn        2068      0      0    0  TRUE TRUE 0.025
## Rtnmin      181    181      0    0  TRUE TRUE 0.009
## bobyqa      824      0      0    0  TRUE TRUE 0.010
## nlnm       1218      0      0    0  TRUE TRUE 0.013
## spg         117     46      0    0  TRUE TRUE 0.006
## lbfgsb3      25     25      0    0  TRUE TRUE 0.008
## L-BFGS-B     25     25      0    0  TRUE TRUE 0.002
## hjkb       1893      0      0    0  TRUE TRUE 0.028
## nmkb        620      0      0    0 FALSE TRUE 0.045
## END : chebyquad
##
## next
```

```
sink()
```

Appendix A: function numbers and names

```
1       rosen
2       freud_roth
3       powell_bs
4       brown_bs
5       beale
6       jenn_samp
7       helical
8       bard
9       gauss
10      meyer
11      gulf
12      box_3d
13      powell_s
14      wood
15      kow_osb
16      brown_den
17      osborne_1
18      biggs_exp6
19      osborne_2
20      watson
21      ex_rosen
22      ex_powell
23      penalty_1
24      penalty_2
25      var_dim
26      trigon
27      brown_al
28      disc_bv
29      disc_ie
30      broyden_tri
31      broyden_band
32      linfun_fr
33      linfun_r1
34      linfun_r1z
35      chebyquad
```

References

Moré, Jorge J., Burton S. Garbow, and Kenneth E. Hillstrom. 1981. "Testing Unconstrained Optimization Software." *J-Toms* 7 (1): 17–41.

Nash, John C, and Ravi Varadhan. 2011. Optimx*: A Replacement and Extension of the optim() Function.* Nash Information Services Inc.; Johns Hopkins University.

R Development Core Team. 2008. ***R****: A Language and Environment for Statistical Computing.* Vienna, Austria: R Foundation for Statistical Computing. http://www.R-project.org.