



calculating the Gradient and the Hessian in R

As you know, the Gradient of a function is the following vector:

The gradient of $f(x, y)$ is

$$Df(x, y) = \begin{bmatrix} \frac{\partial f}{\partial x}(x, y) & \frac{\partial f}{\partial y}(x, y) \end{bmatrix}$$

and the Hessian is the following matrix:

• The Hessian of $f(x, y)$ is

$$D^2f(x, y) = \begin{bmatrix} \frac{\partial^2 f}{\partial^2 x}(x, y) & \frac{\partial^2 f}{\partial y \partial x}(x, y) \\ \frac{\partial^2 f}{\partial x \partial y}(x, y) & \frac{\partial^2 f}{\partial^2 y}(x, y) \end{bmatrix}$$

Now, I wonder, is there any way to calculate these in R for a user defined function at a given point?

First, I've found a package named `numDeriv`, which seems to have the necessary functions `grad` and `hessian` but now I can't get the correct results... Thus, here's my workflow:

Let's say that we are given the function $f(x, y) = x^2 * x^3$, and we need to calculate the Gradient and the Hessian at the point $(x=1, y=2)$.

That's been said, I define this function within R:

```
dummy <- function(x,y) {
  rez <- (z^2)*(y^3)
  rez
}
```

and then use `grad` the following way:

```
grad(func=dummy, x=1, y=2)
```

which gives me result 16 -- and the problem is that this only the first value from a gradient vector, the correct version of which is

```
[16, 12]
```

Same goes with the `hessian` :

```
hessian(func=dummy, x=1, y=2)
```

which gives my 1x1 matrix with the value 16 instead of the 2x2 matrix

```
      [,1] [,2]
[1,]   16   24
[2,]   24   12
```

So, the question is what am I doing wrong?

Thank you.

[r](#) [calculus](#) [derivative](#)

asked Jan 28 '15 at 10:29



[A](#) [S](#)

421 2 13

On a side note, I've also [tried Wolfram|Alpha](#) but also failed to get the correct results... — [A S](#) Jan 28 '15 at 10:31

1 dummy <- function(x) {(x[1]^2)*(x[2]^3)};grad(func=dummy, x=c(1,2));hessian(func=dummy, x=c(1,2)) — [Khashaa](#) Jan 28 '15 at 10:48

Khashaa, yep, I understand now my mistake, thanks :). — [A S](#) Jan 28 '15 at 10:50

1 Answer

You can use the `pracma` library, such as:

```
library(pracma)

dummy <- function(x) {
  z <- x[1]; y <- x[2]
  rez <- (z^2)*(y^3)
  rez
}

grad(dummy, c(1,2))
[1] 16 12

hessian(dummy, c(1,2))
      [,1] [,2]
[1,]   16   24
[2,]   24   12
```

answered Jan 28 '15 at 10:37
user3710546

Pascal, it's damn amazing, thank you so much! :) – [A S](#) Jan 28 '15 at 10:41

3 @AS for future reference, load the `sos` package. It makes it easy to search for key terms. In your case you'd just type `??hessian` to track down this function and package. – [Carl Witthoft](#) Jan 28 '15 at 13:55
