Diferenciación multivariado

Equipo 9

30 de enero de 2019

```
expon <- 1:16
h1 <- 10^(-expon)
h1
```

```
##  [1] 1e-01 1e-02 1e-03 1e-04 1e-05 1e-06 1e-07 1e-08 1e-09 1e-10 1e-11
## [12] 1e-12 1e-13 1e-14 1e-15 1e-16
```

```
f_0 <- 1*3*exp(1^2 + (-2)^2 -5)
```

```
f1 <- function(h){(((1+h)*3*exp((1+h)^2 + (-2)^2 -5))-f_0)/h}
f2 <- function(h){((1*(3+h)*exp(1^2 + (-2)^2 -5))-f_0)/h}
f3 <- function(h){((1*3*exp(1^2 + (-2+h)^2 -5))-f_0)/h}
```

```
r <- data.frame(h = h1) %>% mutate(dir1 = f1(h)-9, dir2 = f2(h)-1, dir3 = f3(h)+12) %>% mutate(norma = s
r
```

```
##        h          dir1          dir2          dir3        norma norma_star
## 1  1e-01  1.711376e+00  8.881784e-16  2.311706e+00 2.876246e+00    15.0333
## 2  1e-02  1.519197e-01 -2.131628e-14  2.656569e-01 3.060280e-01    15.0333
## 3  1e-03  1.501902e-02 -1.101341e-13  2.695606e-02 3.085774e-02    15.0333
## 4  1e-04  1.500190e-03  2.110312e-12  2.699560e-03 3.088397e-03    15.0333
## 5  1e-05  1.500020e-04  6.551204e-12  2.699955e-04 3.088659e-04    15.0333
## 6  1e-06  1.500037e-05  1.397780e-10  2.700117e-05 3.088809e-05    15.0333
## 7  1e-07  1.508497e-06 -1.636579e-09  2.688615e-06 3.082891e-06    15.0333
## 8  1e-08  7.852952e-08 -6.077471e-09  2.949743e-07 3.053091e-07    15.0333
## 9  1e-09  7.446633e-07  8.274037e-08 -9.928845e-07 1.243861e-06    15.0333
## 10 1e-10  7.446633e-07  8.274037e-08 -9.928845e-07 1.243861e-06    15.0333
## 11 1e-11  7.446633e-07  8.274037e-08 -9.928845e-07 1.243861e-06    15.0333
## 12 1e-12  8.001052e-04  8.890058e-05 -1.066807e-03 1.336469e-03    15.0333
## 13 1e-13 -7.193501e-03 -7.992778e-04  9.591334e-03 1.201578e-02    15.0333
## 14 1e-14 -1.182158e-01  2.140518e-02  9.591334e-03 1.205203e-01    15.0333
## 15 1e-15 -1.182158e-01 -1.118216e-01 -1.322676e+00 1.332648e+00    15.0333
## 16 1e-16 -9.000000e+00 -1.000000e+00  1.200000e+01 1.503330e+01    15.0333
##           error
## 1  1.913251e-01
## 2  2.035668e-02
## 3  2.052626e-03
## 4  2.054371e-04
## 5  2.054546e-05
## 6  2.054645e-06
## 7  2.050709e-07
## 8  2.030886e-08
## 9  8.274037e-08
## 10 8.274037e-08
## 11 8.274037e-08
## 12 8.890058e-05
## 13 7.992778e-04
## 14 8.016894e-03
## 15 8.864645e-02
```

```
## 16 1.000000e+00
```

```
ggplot(r, aes(x=log(h), y=log(error))) +
  geom_point() +
  geom_line()
```