sol2.rmd

```
library(fOptions)
```

```
## Loading required package: timeDate
```

```
## Loading required package: timeSeries
```

```
## Loading required package: fBasics
```

```
r = 0.05
b = r
v = 0.32
s = 50
k = c(45,50,45,55,45,50)
tau = c(3,6,6,12,12,9)/12
otype = c("c","c","p","c","c","c")
greeks = mapply(GBSCharacteristics,otype,s,k,tau,r,b,v)
greeks = t(greeks)
greeks
```

```
##   premium  delta      theta     vega     rho      lambda    gamma
## c 6.569484 0.7929296  -6.227032 7.145598 8.269249 6.034946  0.03572799
## c 5.092561 0.5884744  -5.61862  13.75644 12.16558 5.777784  0.03439111
## p 1.852028 -0.2453315 -2.853287 11.12255 -7.0593  -6.623321 0.02780638
## c 5.408958 0.5073424  -4.188906 19.94374 19.95816 4.689835  0.02492967
## c 10.17036 0.740699   -3.934548 16.19574 26.86459 3.641458  0.02024468
## c 6.378122 0.6079117  -4.750487 16.63881 18.0131  4.765601  0.02773136
```

```
prices = as.numeric(greeks[,1])
deltas = as.numeric(greeks[,2])
vegas = as.numeric(greeks[,4])
gammas = as.numeric(greeks[,7])
#add a row for the stock
types = c("call","call","put","call","call","call","stock")
pos = c(-1000, -500, 2000, -1500, 0, 0, 0)
prices = c(prices,s)
deltas = c(deltas,1)
gammas = c(gammas,0)
vegas = c(vegas,0)
table0 = data.frame(types,pos,prices,deltas,gammas,vegas)
table0
```

```
##   types   pos    prices     deltas     gammas     vegas
## 1  call -1000  6.569484  0.7929296 0.03572799  7.145598
## 2  call  -500  5.092561  0.5884744 0.03439111 13.756444
## 3   put  2000  1.852028 -0.2453315 0.02780638 11.122554
## 4  call -1500  5.408958  0.5073424 0.02492967 19.943736
## 5  call     0 10.170362  0.7406990 0.02024468 16.195741
## 6  call     0  6.378122  0.6079117 0.02773136 16.638814
## 7 stock     0 50.000000  1.0000000 0.00000000  0.000000
```

```r
#naked portfolio greeks and values
# a) find z for option A to make it delta neutral
# z1 * d1 + z2 * d2 + z3 * d3 + z4 *d4 +z5 *d5 = 0
z5 = -(0.7929   * -1000 +0.5885*-500    +-0.2453    * 2000  +0.5073 *-1500) /0.7407
z5  #position z in A to make it delta - neutral
```

```
## [1] 3157.419
```

```r
# buy 3157.419 options
#gamma of this portfolio
# z1 * gamma1 + z2 * gamma2 + z3 * gamma3 + z4 *gamma4 +z5 *gamma5

gamma_portfolio = 0.03573   * -1000 +0.03439*-500   +0.02781    * 2000  +0.02493*-1500 + z5 * 0.02024
gamma_portfolio
```

```
## [1] 29.20615
```

```r
#b) delta-gamma neutral
d0 = table0[,-c(1,2)]
d0 = as.matrix(d0)
portfolio0 = pos%*%d0
portfolio0
```

```
##         prices    deltas    gammas     vegas
## [1,] -13525.15 -2338.843 -34.70528 -21694.32
```

```r
price = portfolio0[1]      # portfolio value
pdelta = portfolio0[2]     # Delta_naked
pgama = portfolio0[3]      # Gamma_naked
pvega = portfolio0[4]
b = c(-pdelta,-pgama)
b
```

```
## [1] 2338.84338   34.70528
```

```r
c1 = c(1,0)
c2 = c(deltas[5],gammas[5])
A = cbind(c1,c2)
A
```

```
##      c1         c2
## [1,]  1 0.74069898
## [2,]  0 0.02024468
```

```r
asol = solve(A,b)
asol
```

```
##       c1       c2
## 1069.069 1714.292
```

```r
#buy x = 1069 shares
# z5 = 1714 options to buy

#vega of this portfolio
# z1 * vega1 + z2 * vega2 + z3 * vega3 + z4 *vega4 +z5 *vega5
vega_portfolio = 7.146  * -1000 +13.76*-500 +11.12  * 2000  +19.94*-1500 + z5 * 16.196
vega_portfolio
```

```
## [1] 29441.55
```

```r
#c) delta-gamma-vega neutral
b = c(-pdelta,-pgama,-pvega)
b
```

```
## [1]  2338.84338    34.70528 21694.31547
```

```r
c1 = c(1,0,0)
c2 = c(deltas[5],gammas[5],vegas[5])
c3 = c(deltas[6],gammas[6],vegas[6])

A = cbind(c1,c2,c3)
A
```

```
##      c1          c2          c3
## [1,]  1  0.74069898  0.60791172
## [2,]  0  0.02024468  0.02773136
## [3,]  0 16.19574101 16.63881406
```

```r
csol = solve(A,b)
csol
```

```
##        c1        c2        c3
## 1514.1723  215.1549 1094.4123
```

```r
# buy 1514.2 shares
# buy 215.2 options A
# buy 1094.4 options B
```