```
options("getSymbols.warning4.0"=FALSE)
Sys.setenv(TZ="UTC")
currency('USD')
```

```
[1] "USD"
```

```
initDate = "1990-01-01"
from = "2003-01-01"
to = "2013-12-31"
options(width = 70)
```

Options

R QuantLib

```
lsf.str("package:RQuantLib")
```

```
addHolidays : function (calendar, dates)
adjust : function (calendar, dates, bdc = 0L)
advance : function (calendar = "TARGET", dates = Sys.Date(), n, timeUnit,
    period, bdc = 0, emr = 0)
advanceDate : function (issueDate, days)
AffineSwaption : function (params, ts, swaptionMaturities, swapTenors, volMatrix,
    legparams = list(dayCounter = "Thirty360", fixFreq = "Annual",
        floatFreq = "Semiannual"))
AmericanOption : function (type, underlying, strike, dividendYield, riskFreeRate,
    maturity, volatility, timeSteps = 150, gridPoints = 149,
    engine = "BaroneAdesiWhaley", discreteDividends = NULL, discreteDividendsTimeUntil = NULL)
AmericanOptionImpliedVolatility : function (type, value, underlying, strike, dividendYield, ris
    maturity, volatility, timeSteps = 150, gridPoints = 151)
AsianOption : function (averageType, type, underlying, strike, dividendYield,
    riskFreeRate, maturity, volatility, first, length, fixings)
BarrierOption : function (barrType, type, underlying, strike, dividendYield,
    riskFreeRate, maturity, volatility, barrier, rebate = 0)
BermudanSwaption : function (params, ts, swaptionMaturities, swapTenors, volMatrix)
BinaryOption : function (binType, type, excType, underlying, strike, dividendYield,
    riskFreeRate, maturity, volatility, cashPayoff)
BinaryOptionImpliedVolatility : function (type, value, underlying, strike, dividendYield, riskF
    maturity, volatility, cashPayoff = 1)
businessDay : function (calendar = "TARGET", dates = Sys.Date())
businessDaysBetween : function (calendar, from, to, includeFirst = TRUE, includeLast = FALSE)
CallableBond : function (bondparams, hullWhite, coupon, dateparams)
ConvertibleFixedCouponBond : function (bondparams, coupon, process, dateparams)
ConvertibleFloatingCouponBond : function (bondparams, iborindex, spread, process, dateparams)
```

```
ConvertibleZeroCouponBond : function (bondparams, process, dateparams)
dayCount : function (startDates, endDates, dayCounters)
DiscountCurve : function (params, tsQuotes, times = seq(0, 10, 0.1), legparams = list(dayCounte
    fixFreq = "Annual", floatFreq = "Semiannual"))
endOfMonth : function (calendar = "TARGET", dates = Sys.Date())
EuropeanOption : function (type, underlying, strike, dividendYield, riskFreeRate,
    maturity, volatility, discreteDividends = NULL, discreteDividendsTimeUntil = NULL)
EuropeanOptionArrays : function (type, underlying, strike, dividendYield, riskFreeRate,
    maturity, volatility)
EuropeanOptionImpliedVolatility : function (type, value, underlying, strike, dividendYield, ris
    maturity, volatility)
FittedBondCurve : function (curveparams, lengths, coupons, marketQuotes, dateparams)
FixedRateBond : function (bond, rates, schedule, calc, discountCurve, yield,
    price)
FixedRateBondPriceByYield : function (settlementDays, yield, faceAmount, effectiveDate, maturit
    period, calendar, rates, dayCounter, businessDayConvention,
    compound, redemption, issueDate)
FixedRateBondYield : function (settlementDays, price, faceAmount, effectiveDate, maturityDate,
    period, calendar, rates, dayCounter, businessDayConvention,
    compound, redemption, issueDate)
FloatingRateBond : function (bond, gearings, spreads, caps, floors, index, curve,
    dateparams)
getEndOfMonth : function (calendar, dates)
getHolidayList : function (calendar, from, to, includeWeekends = FALSE)
getQuantLibCapabilities : function ()
getQuantLibVersion : function ()
holidayList : function (calendar = "TARGET", from = Sys.Date(), to = Sys.Date() +
    5, includeWeekends = FALSE)
isBusinessDay : function (calendar, dates)
isEndOfMonth : function (calendar, dates)
isHoliday : function (calendar, dates)
isWeekend : function (calendar, dates)
matchParams : function (params)
oldEuropeanOptionArrays : function (type, underlying, strike, dividendYield, riskFreeRate,
    maturity, volatility)
plot.DiscountCurve : function (x, setpar = TRUE, dolegend = TRUE, ...)
plotOptionSurface : function (EOres, ylabel = "", xlabel = "", zlabel = "", fov = 60)
removeHolidays : function (calendar, dates)
SabrSwaption : function (params, ts, volCubeDF, legparams = list(dayCounter = "Thirty360",
    fixFreq = "Annual", floatFreq = "Semiannual"), tsUp01 = NA,
    tsDn01 = NA, vega = FALSE)
Schedule : function (params)
setCalendarContext : function (calendar, fixingDays, settleDate)
setEvaluationDate : function (evalDate)
summary.BKTree : function (object, ...)
```

```
summary.G2Analytic : function (object, ...)
summary.HWAnalytic : function (object, ...)
summary.HWTree : function (object, ...)
yearFraction : function (startDates, endDates, dayCounters)
ZeroCouponBond : function (bond, discountCurve, dateparams)
ZeroPriceByYield : function (yield, faceAmount, issueDate, maturityDate, dayCounter,
    frequency, compound, businessDayConvention)
ZeroYield : function (price, faceAmount, issueDate, maturityDate, dayCounter,
    frequency, compound, businessDayConvention)
```

Closed-form solutions:

$$c = SN(d_1) - Ke^{-rT}N(d_2)$$
$$p = -Ke^{-rT}N(-d_2) - SN(-d_1)$$

Valuation

```
call_value <- EuropeanOption(type = "call", underlying = 100,
                             strike = 100, dividendYield = 0, riskFreeRate = 0.03,
                             maturity = 1.0, volatility = .3)

call_value
```

```
Concise summary of valuation for EuropeanOption
    value    delta    gamma     vega    theta      rho   divRho
  13.2833   0.5987   0.0129  38.6668  -7.1976  46.5873 -59.8706
```

```
class(call_value)
```

```
[1] "EuropeanOption" "Option"
```

```
type <- "call"
underlying <- 20:180
strike <- 100
dividendYield <- 0
riskFreeRate <- 0.03
maturity <- 1.0
volatility <- 0.10

# Function to create plots of option values and Greeks.

option_values <- function(type, underlying, strike,
                          dividendYield, riskFreeRate, maturity, volatility) {
  # Output list with option values and Greeks

  out <- list()
```

```r
for(i in seq_along(underlying)) {
  out[[i]] <- EuropeanOption(type = type, underlying = i,
                             strike = strike, dividendYield = dividendYield,
                             riskFreeRate = riskFreeRate, maturity = maturity,
                             volatility = volatility)
}

# Set up plot window
par(mfrow = c(3, 2))
names <- c("Value", "Delta", "Gamma",
           "Vega", "Theta", "Rho")

for(i in 1:6)
{
  plot(unlist(lapply(out, "[", i)), type = "l",
                     main = paste(names[i], "vs. Underlying"),
                     xlab = "Underlying", ylab = names[i])
  grid()
  abline(v = strike, col = "red")
}

  return(out)
}
```
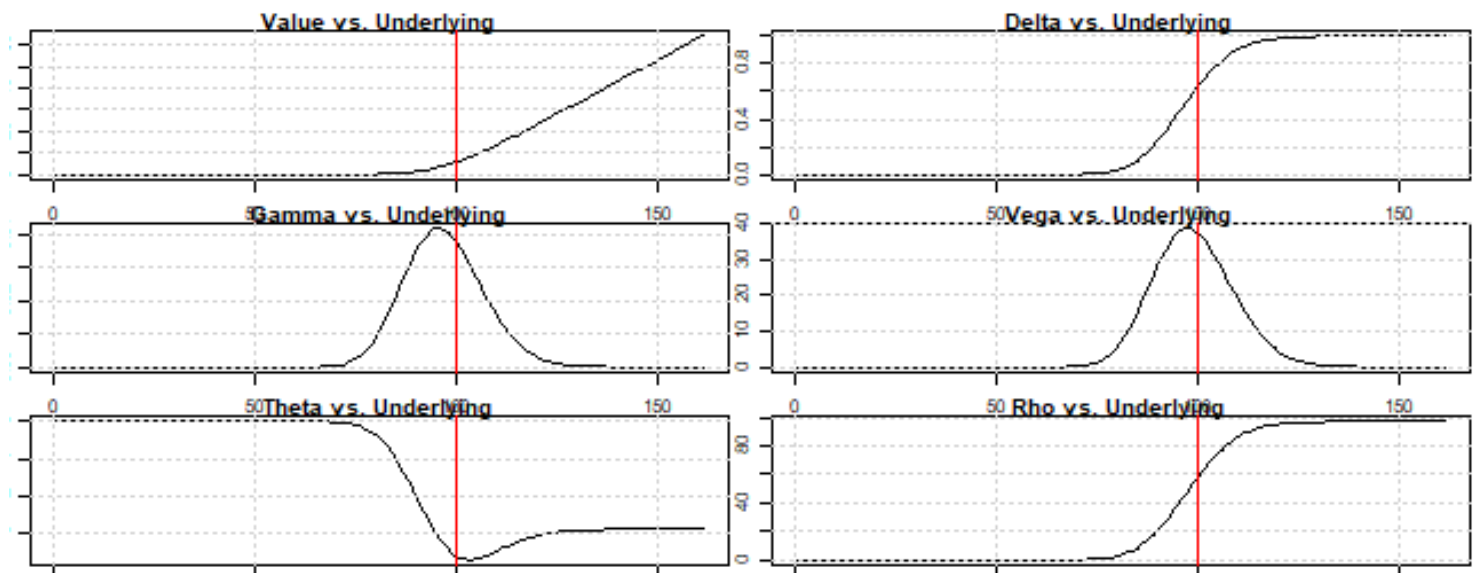
```r
par(mar=c(1,1,1,1))
```

```r
option_values(type, underlying, strike, dividendYield,
              riskFreeRate, maturity, volatility)
```

```
[[1]]
Concise summary of valuation for EuropeanOption
 value  delta  gamma   vega  theta    rho divRho
     0      0      0      0      0      0      0


[[2]]
Concise summary of valuation for EuropeanOption
 value  delta  gamma   vega  theta    rho divRho
     0      0      0      0      0      0      0


[[3]]
Concise summary of valuation for EuropeanOption
 value  delta  gamma   vega  theta    rho divRho
     0      0      0      0      0      0      0


[[4]]
Concise summary of valuation for EuropeanOption
 value  delta  gamma   vega  theta    rho divRho
     0      0      0      0      0      0      0


[[5]]
Concise summary of valuation for EuropeanOption
 value  delta  gamma   vega  theta    rho divRho
     0      0      0      0      0      0      0


[[6]]
Concise summary of valuation for EuropeanOption
 value  delta  gamma   vega  theta    rho divRho
     0      0      0      0      0      0      0


[[7]]
Concise summary of valuation for EuropeanOption
 value  delta  gamma   vega  theta    rho divRho
     0      0      0      0      0      0      0


[[8]]
Concise summary of valuation for EuropeanOption
 value  delta  gamma   vega  theta    rho divRho
     0      0      0      0      0      0      0


[[9]]
Concise summary of valuation for EuropeanOption
 value  delta  gamma   vega  theta    rho divRho
     0      0      0      0      0      0      0
```

```
[[10]]
Concise summary of valuation for EuropeanOption
 value  delta  gamma   vega  theta    rho divRho
     0      0      0      0      0      0      0

[[11]]
Concise summary of valuation for EuropeanOption
 value  delta  gamma   vega  theta    rho divRho
     0      0      0      0      0      0      0

[[12]]
Concise summary of valuation for EuropeanOption
 value  delta  gamma   vega  theta    rho divRho
     0      0      0      0      0      0      0

[[13]]
Concise summary of valuation for EuropeanOption
 value  delta  gamma   vega  theta    rho divRho
     0      0      0      0      0      0      0

[[14]]
Concise summary of valuation for EuropeanOption
 value  delta  gamma   vega  theta    rho divRho
     0      0      0      0      0      0      0

[[15]]
Concise summary of valuation for EuropeanOption
 value  delta  gamma   vega  theta    rho divRho
     0      0      0      0      0      0      0

[[16]]
Concise summary of valuation for EuropeanOption
 value  delta  gamma   vega  theta    rho divRho
     0      0      0      0      0      0      0

[[17]]
Concise summary of valuation for EuropeanOption
 value  delta  gamma   vega  theta    rho divRho
     0      0      0      0      0      0      0

[[18]]
Concise summary of valuation for EuropeanOption
 value  delta  gamma   vega  theta    rho divRho
     0      0      0      0      0      0      0
```

```
[[19]]
Concise summary of valuation for EuropeanOption
 value  delta  gamma   vega  theta    rho divRho
     0      0      0      0      0      0      0

[[20]]
Concise summary of valuation for EuropeanOption
 value  delta  gamma   vega  theta    rho divRho
     0      0      0      0      0      0      0

[[21]]
Concise summary of valuation for EuropeanOption
 value  delta  gamma   vega  theta    rho divRho
     0      0      0      0      0      0      0

[[22]]
Concise summary of valuation for EuropeanOption
 value  delta  gamma   vega  theta    rho divRho
     0      0      0      0      0      0      0

[[23]]
Concise summary of valuation for EuropeanOption
 value  delta  gamma   vega  theta    rho divRho
     0      0      0      0      0      0      0

[[24]]
Concise summary of valuation for EuropeanOption
 value  delta  gamma   vega  theta    rho divRho
     0      0      0      0      0      0      0

[[25]]
Concise summary of valuation for EuropeanOption
 value  delta  gamma   vega  theta    rho divRho
     0      0      0      0      0      0      0

[[26]]
Concise summary of valuation for EuropeanOption
 value  delta  gamma   vega  theta    rho divRho
     0      0      0      0      0      0      0

[[27]]
Concise summary of valuation for EuropeanOption
 value  delta  gamma   vega  theta    rho divRho
     0      0      0      0      0      0      0
```

```
[[28]]
Concise summary of valuation for EuropeanOption
 value  delta  gamma   vega  theta    rho divRho
     0      0      0      0      0      0      0

[[29]]
Concise summary of valuation for EuropeanOption
 value  delta  gamma   vega  theta    rho divRho
     0      0      0      0      0      0      0

[[30]]
Concise summary of valuation for EuropeanOption
 value  delta  gamma   vega  theta    rho divRho
     0      0      0      0      0      0      0

[[31]]
Concise summary of valuation for EuropeanOption
 value  delta  gamma   vega  theta    rho divRho
     0      0      0      0      0      0      0

[[32]]
Concise summary of valuation for EuropeanOption
 value  delta  gamma   vega  theta    rho divRho
     0      0      0      0      0      0      0

[[33]]
Concise summary of valuation for EuropeanOption
 value  delta  gamma   vega  theta    rho divRho
     0      0      0      0      0      0      0

[[34]]
Concise summary of valuation for EuropeanOption
 value  delta  gamma   vega  theta    rho divRho
     0      0      0      0      0      0      0

[[35]]
Concise summary of valuation for EuropeanOption
 value  delta  gamma   vega  theta    rho divRho
     0      0      0      0      0      0      0

[[36]]
Concise summary of valuation for EuropeanOption
 value  delta  gamma   vega  theta    rho divRho
     0      0      0      0      0      0      0
```

```
[[37]]
Concise summary of valuation for EuropeanOption
 value  delta  gamma   vega  theta    rho divRho
     0      0      0      0      0      0      0

[[38]]
Concise summary of valuation for EuropeanOption
 value  delta  gamma   vega  theta    rho divRho
     0      0      0      0      0      0      0

[[39]]
Concise summary of valuation for EuropeanOption
 value  delta  gamma   vega  theta    rho divRho
     0      0      0      0      0      0      0

[[40]]
Concise summary of valuation for EuropeanOption
 value  delta  gamma   vega  theta    rho divRho
     0      0      0      0      0      0      0

[[41]]
Concise summary of valuation for EuropeanOption
 value  delta  gamma   vega  theta    rho divRho
     0      0      0      0      0      0      0

[[42]]
Concise summary of valuation for EuropeanOption
 value  delta  gamma   vega  theta    rho divRho
     0      0      0      0      0      0      0

[[43]]
Concise summary of valuation for EuropeanOption
 value  delta  gamma   vega  theta    rho divRho
     0      0      0      0      0      0      0

[[44]]
Concise summary of valuation for EuropeanOption
 value  delta  gamma   vega  theta    rho divRho
     0      0      0      0      0      0      0

[[45]]
Concise summary of valuation for EuropeanOption
 value  delta  gamma   vega  theta    rho divRho
     0      0      0      0      0      0      0
```

```
[[46]]
Concise summary of valuation for EuropeanOption
 value  delta  gamma   vega  theta    rho divRho
     0      0      0      0      0      0      0


[[47]]
Concise summary of valuation for EuropeanOption
 value  delta  gamma   vega  theta    rho divRho
     0      0      0      0      0      0      0


[[48]]
Concise summary of valuation for EuropeanOption
 value  delta  gamma   vega  theta    rho divRho
     0      0      0      0      0      0      0


[[49]]
Concise summary of valuation for EuropeanOption
 value  delta  gamma   vega  theta    rho divRho
     0      0      0      0      0      0      0


[[50]]
Concise summary of valuation for EuropeanOption
 value  delta  gamma   vega  theta    rho divRho
     0      0      0      0      0      0      0


[[51]]
Concise summary of valuation for EuropeanOption
 value  delta  gamma   vega  theta    rho divRho
     0      0      0      0      0      0      0


[[52]]
Concise summary of valuation for EuropeanOption
 value  delta  gamma   vega  theta    rho divRho
     0      0      0      0      0      0      0


[[53]]
Concise summary of valuation for EuropeanOption
 value  delta  gamma   vega  theta    rho divRho
     0      0      0      0      0      0      0


[[54]]
Concise summary of valuation for EuropeanOption
 value  delta  gamma   vega  theta    rho divRho
     0      0      0      0      0      0      0
```

```
[[55]]
Concise summary of valuation for EuropeanOption
 value  delta  gamma   vega  theta    rho divRho
     0      0      0      0      0      0      0


[[56]]
Concise summary of valuation for EuropeanOption
 value  delta  gamma   vega  theta    rho divRho
     0      0      0      0      0      0      0


[[57]]
Concise summary of valuation for EuropeanOption
 value  delta  gamma   vega  theta    rho divRho
     0      0      0      0      0      0      0


[[58]]
Concise summary of valuation for EuropeanOption
 value  delta  gamma   vega  theta    rho divRho
 0e+00  0e+00  0e+00  1e-04  0e+00  0e+00  0e+00


[[59]]
Concise summary of valuation for EuropeanOption
 value  delta  gamma   vega  theta    rho divRho
 0e+00  0e+00  0e+00  1e-04  0e+00  0e+00  0e+00


[[60]]
Concise summary of valuation for EuropeanOption
 value  delta  gamma   vega  theta    rho divRho
 0e+00  0e+00  0e+00  3e-04  0e+00  1e-04 -1e-04


[[61]]
Concise summary of valuation for EuropeanOption
 value  delta  gamma   vega  theta    rho divRho
 0e+00  0e+00  0e+00  6e-04  0e+00  1e-04 -1e-04


[[62]]
Concise summary of valuation for EuropeanOption
  value   delta   gamma    vega   theta     rho  divRho
 0.0000  0.0000  0.0000  0.0014 -0.0001  0.0003 -0.0003


[[63]]
Concise summary of valuation for EuropeanOption
  value   delta   gamma    vega   theta     rho  divRho
 0.0000  0.0000  0.0000  0.0028 -0.0002  0.0006 -0.0006
```

```
[[64]]
Concise summary of valuation for EuropeanOption
   value    delta   gamma    vega    theta     rho  divRho
  0.0000   0.0000  0.0000  0.0054 -0.0003  0.0012 -0.0013

[[65]]
Concise summary of valuation for EuropeanOption
   value    delta   gamma    vega    theta     rho  divRho
  0.0001   0.0000  0.0000  0.0103 -0.0006  0.0024 -0.0025

[[66]]
Concise summary of valuation for EuropeanOption
   value    delta   gamma    vega    theta     rho  divRho
  0.0001   0.0001  0.0000  0.0189 -0.0011  0.0046 -0.0047

[[67]]
Concise summary of valuation for EuropeanOption
   value    delta   gamma    vega    theta     rho  divRho
  0.0002   0.0001  0.0001  0.0336 -0.0019  0.0084 -0.0086

[[68]]
Concise summary of valuation for EuropeanOption
   value    delta   gamma    vega    theta     rho  divRho
  0.0004   0.0002  0.0001  0.0580 -0.0034  0.0151 -0.0154

[[69]]
Concise summary of valuation for EuropeanOption
   value    delta   gamma    vega    theta     rho  divRho
  0.0007   0.0004  0.0002  0.0971 -0.0056  0.0261 -0.0268

[[70]]
Concise summary of valuation for EuropeanOption
   value    delta   gamma    vega    theta     rho  divRho
  0.0012   0.0006  0.0003  0.1582 -0.0092  0.0442 -0.0454

[[71]]
Concise summary of valuation for EuropeanOption
   value    delta   gamma    vega    theta     rho  divRho
  0.0020   0.0011  0.0005  0.2506 -0.0147  0.0727 -0.0748

[[72]]
Concise summary of valuation for EuropeanOption
   value    delta   gamma    vega    theta     rho  divRho
  0.0034   0.0017  0.0007  0.3869 -0.0228  0.1167 -0.1201
```

```
[[73]]
Concise summary of valuation for EuropeanOption
  value   delta   gamma    vega    theta      rho   divRho
 0.0055  0.0026  0.0011  0.5825 -0.0346   0.1827 -0.1882

[[74]]
Concise summary of valuation for EuropeanOption
  value   delta   gamma    vega    theta      rho   divRho
 0.0087  0.0039  0.0016  0.8560 -0.0512   0.2796 -0.2882

[[75]]
Concise summary of valuation for EuropeanOption
  value   delta   gamma    vega    theta      rho   divRho
 0.0134  0.0058  0.0022  1.2289 -0.0740   0.4182 -0.4316

[[76]]
Concise summary of valuation for EuropeanOption
  value   delta   gamma    vega    theta      rho   divRho
 0.0204  0.0083  0.0030  1.7251 -0.1046   0.6123 -0.6327

[[77]]
Concise summary of valuation for EuropeanOption
  value   delta   gamma    vega    theta      rho   divRho
 0.0304  0.0118  0.0040  2.3698 -0.1448   0.8781 -0.9084

[[78]]
Concise summary of valuation for EuropeanOption
  value   delta   gamma    vega    theta      rho   divRho
 0.0444  0.0164  0.0052  3.1883 -0.1965   1.2345 -1.2789

[[79]]
Concise summary of valuation for EuropeanOption
  value   delta   gamma    vega    theta      rho   divRho
 0.0636  0.0224  0.0067  4.2040 -0.2613   1.7030 -1.7667

[[80]]
Concise summary of valuation for EuropeanOption
  value   delta   gamma    vega    theta      rho   divRho
 0.0896  0.0300  0.0085  5.4368 -0.3410   2.3069 -2.3965

[[81]]
Concise summary of valuation for EuropeanOption
  value   delta   gamma    vega    theta      rho   divRho
 0.1242  0.0394  0.0105  6.9007 -0.4371   3.0705 -3.1947
```

```
[[82]]
Concise summary of valuation for EuropeanOption
  value   delta   gamma    vega   theta     rho  divRho
 0.1692  0.0511  0.0128  8.6018 -0.5507  4.0190 -4.1882

[[83]]
Concise summary of valuation for EuropeanOption
  value   delta   gamma    vega   theta     rho  divRho
 0.2271  0.0651  0.0153 10.5368 -0.6821  5.1764 -5.4035

[[84]]
Concise summary of valuation for EuropeanOption
  value   delta   gamma    vega   theta     rho  divRho
 0.3003  0.0817  0.0180 12.6912 -0.8315  6.5649 -6.8653

[[85]]
Concise summary of valuation for EuropeanOption
  value   delta   gamma    vega   theta     rho  divRho
 0.3915  0.1011  0.0208 15.0392 -0.9981  8.2038 -8.5953

[[86]]
Concise summary of valuation for EuropeanOption
   value    delta    gamma     vega    theta      rho    divRho
  0.5035   0.1234   0.0237  17.5431  -1.1804  10.1076 -10.6111

[[87]]
Concise summary of valuation for EuropeanOption
   value    delta    gamma     vega    theta      rho    divRho
  0.6392   0.1486   0.0266  20.1548  -1.3763  12.2857 -12.9249

[[88]]
Concise summary of valuation for EuropeanOption
   value    delta    gamma     vega    theta      rho    divRho
  0.8016   0.1766   0.0295  22.8168  -1.5831  14.7407 -15.5423

[[89]]
Concise summary of valuation for EuropeanOption
   value    delta    gamma     vega    theta      rho    divRho
  0.9934   0.2074   0.0321  25.4651  -1.7973  17.4687 -18.4621

[[90]]
Concise summary of valuation for EuropeanOption
   value    delta    gamma     vega    theta      rho    divRho
  1.2173   0.2408   0.0346  28.0318  -2.0153  20.4582 -21.6755
```

```
[[91]]
Concise summary of valuation for EuropeanOption
   value    delta    gamma     vega    theta      rho    divRho
  1.4759   0.2766   0.0368  30.4484  -2.2331  23.6906 -25.1665

[[92]]
Concise summary of valuation for EuropeanOption
   value    delta    gamma     vega    theta      rho    divRho
  1.7711   0.3143   0.0386  32.6489  -2.4467  27.1406 -28.9118

[[93]]
Concise summary of valuation for EuropeanOption
   value    delta    gamma     vega    theta      rho    divRho
  2.1049   0.3536   0.0400  34.5733  -2.6520  30.7769 -32.8818

[[94]]
Concise summary of valuation for EuropeanOption
   value    delta    gamma     vega    theta      rho    divRho
  2.4786   0.3941   0.0409  36.1704  -2.8454  34.5630 -37.0416

[[95]]
Concise summary of valuation for EuropeanOption
   value    delta    gamma     vega    theta      rho    divRho
  2.8933   0.4353   0.0414  37.3998  -3.0238  38.4589 -41.3521

[[96]]
Concise summary of valuation for EuropeanOption
   value    delta    gamma     vega    theta      rho    divRho
  3.3493   0.4768   0.0415  38.2336  -3.1843  42.4222 -45.7715

[[97]]
Concise summary of valuation for EuropeanOption
   value    delta    gamma     vega    theta      rho    divRho
  3.8468   0.5181   0.0411  38.6575  -3.3252  46.4098 -50.2566

[[98]]
Concise summary of valuation for EuropeanOption
   value    delta    gamma     vega    theta      rho    divRho
  4.3853   0.5588   0.0403  38.6707  -3.4449  50.3788 -54.7642

[[99]]
Concise summary of valuation for EuropeanOption
   value    delta    gamma     vega    theta      rho    divRho
  4.9641   0.5985   0.0391  38.2850  -3.5429  54.2886 -59.2527
```

```
[[100]]
Concise summary of valuation for EuropeanOption
   value    delta    gamma     vega    theta      rho    divRho
  5.5819   0.6368   0.0375  37.5240  -3.6192  58.1012  -63.6831

[[101]]
Concise summary of valuation for EuropeanOption
   value    delta    gamma     vega    theta      rho    divRho
  6.2372   0.6735   0.0357  36.4214  -3.6746  61.7829  -68.0200

[[102]]
Concise summary of valuation for EuropeanOption
   value    delta    gamma     vega    theta      rho    divRho
  6.9282   0.7082   0.0337  35.0182  -3.7100  65.3045  -72.2326

[[103]]
Concise summary of valuation for EuropeanOption
   value    delta    gamma     vega    theta      rho    divRho
  7.6528   0.7407   0.0314  33.3614  -3.7273  68.6421  -76.2949

[[104]]
Concise summary of valuation for EuropeanOption
   value    delta    gamma     vega    theta      rho    divRho
  8.4089   0.7710   0.0291  31.5009  -3.7284  71.7771  -80.1860

[[105]]
Concise summary of valuation for EuropeanOption
   value    delta    gamma     vega    theta      rho    divRho
  9.1940   0.7990   0.0267  29.4880  -3.7153  74.6964  -83.8905

[[106]]
Concise summary of valuation for EuropeanOption
   value    delta    gamma     vega    theta      rho    divRho
 10.0060   0.8245   0.0244  27.3727  -3.6904  77.3921  -87.3980

[[107]]
Concise summary of valuation for EuropeanOption
   value    delta    gamma     vega    theta      rho    divRho
 10.8423   0.8477   0.0220  25.2027  -3.6560  79.8608  -90.7031

[[108]]
Concise summary of valuation for EuropeanOption
   value    delta    gamma     vega    theta      rho    divRho
 11.7006   0.8686   0.0197  23.0215  -3.6142  82.1039  -93.8045
```

```
[[109]]
Concise summary of valuation for EuropeanOption
   value    delta    gamma     vega    theta      rho    divRho
 12.5787   0.8872   0.0176  20.8678  -3.5672  84.1263 -96.7049


[[110]]
Concise summary of valuation for EuropeanOption
   value    delta    gamma     vega    theta      rho    divRho
 13.4743   0.9037   0.0155  18.7746  -3.5168  85.9360 -99.4103


[[111]]
Concise summary of valuation for EuropeanOption
   value    delta    gamma     vega     theta      rho     divRho
 14.3855   0.9183   0.0136  16.7690   -3.4648   87.5437 -101.9292


[[112]]
Concise summary of valuation for EuropeanOption
   value    delta    gamma     vega     theta      rho     divRho
 15.3102   0.9310   0.0119  14.8722   -3.4125   88.9619 -104.2721


[[113]]
Concise summary of valuation for EuropeanOption
   value    delta    gamma     vega     theta      rho     divRho
 16.2469   0.9420   0.0103  13.0996   -3.3611   90.2042 -106.4511


[[114]]
Concise summary of valuation for EuropeanOption
   value    delta    gamma     vega     theta      rho     divRho
 17.1938   0.9516   0.0088  11.4615   -3.3116   91.2853 -108.4791


[[115]]
Concise summary of valuation for EuropeanOption
   value    delta    gamma     vega     theta      rho     divRho
 18.1496   0.9597   0.0075   9.9633   -3.2648   92.2199 -110.3695


[[116]]
Concise summary of valuation for EuropeanOption
   value    delta    gamma     vega     theta      rho     divRho
 19.1129   0.9667   0.0064   8.6064   -3.2210   93.0229 -112.1358


[[117]]
Concise summary of valuation for EuropeanOption
   value    delta    gamma     vega     theta      rho     divRho
 20.0826   0.9726   0.0054   7.3888   -3.1807   93.7085 -113.7911
```

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[[118]]
Concise summary of valuation for EuropeanOption
    value    delta    gamma     vega    theta      rho    divRho
  21.0577   0.9775   0.0045   6.3056  -3.1440  94.2904 -115.3481

[[119]]
Concise summary of valuation for EuropeanOption
    value    delta    gamma     vega    theta      rho    divRho
  22.0374   0.9817   0.0038   5.3501  -3.1109  94.7814 -116.8187

[[120]]
Concise summary of valuation for EuropeanOption
    value    delta    gamma     vega    theta      rho    divRho
  23.0208   0.9851   0.0031   4.5137  -3.0815  95.1933 -118.2142

[[121]]
Concise summary of valuation for EuropeanOption
    value    delta    gamma     vega    theta      rho    divRho
  24.0074   0.9880   0.0026   3.7872  -3.0555  95.5371 -119.5445

[[122]]
Concise summary of valuation for EuropeanOption
    value    delta    gamma     vega    theta      rho    divRho
  24.9966   0.9903   0.0021   3.1606  -3.0327  95.8224 -120.8190

[[123]]
Concise summary of valuation for EuropeanOption
    value    delta    gamma     vega    theta      rho    divRho
  25.9879   0.9922   0.0017   2.6240  -3.0129  96.0579 -122.0459

[[124]]
Concise summary of valuation for EuropeanOption
    value    delta    gamma     vega    theta      rho    divRho
  26.9810   0.9938   0.0014   2.1675  -2.9959  96.2514 -123.2324

[[125]]
Concise summary of valuation for EuropeanOption
    value    delta    gamma     vega    theta      rho    divRho
  27.9754   0.9951   0.0011   1.7815  -2.9814  96.4096 -124.3851

[[126]]
Concise summary of valuation for EuropeanOption
    value    delta    gamma     vega    theta      rho    divRho
  28.9711   0.9961   0.0009   1.4573  -2.9690  96.5383 -125.5093
```

```
[[127]]
Concise summary of valuation for EuropeanOption
     value      delta      gamma       vega      theta        rho      divRho
   29.9676     0.9969     0.0007     1.1865    -2.9586    96.6425  -126.6101


[[128]]
Concise summary of valuation for EuropeanOption
     value      delta      gamma       vega      theta        rho      divRho
   30.9649     0.9976     0.0006     0.9616    -2.9499    96.7264  -127.6913


[[129]]
Concise summary of valuation for EuropeanOption
     value      delta      gamma       vega      theta        rho      divRho
   31.9627     0.9981     0.0005     0.7759    -2.9426    96.7938  -128.7565


[[130]]
Concise summary of valuation for EuropeanOption
     value      delta      gamma       vega      theta        rho      divRho
   32.9610     0.9985     0.0004     0.6233    -2.9366    96.8477  -129.8087


[[131]]
Concise summary of valuation for EuropeanOption
     value      delta      gamma       vega      theta        rho      divRho
   33.9597     0.9989     0.0003     0.4987    -2.9316    96.8905  -130.8502


[[132]]
Concise summary of valuation for EuropeanOption
     value      delta      gamma       vega      theta        rho      divRho
   34.9587     0.9991     0.0002     0.3973    -2.9276    96.9244  -131.8832


[[133]]
Concise summary of valuation for EuropeanOption
     value      delta      gamma       vega      theta        rho      divRho
   35.9580     0.9993     0.0002     0.3153    -2.9243    96.9512  -132.9092


[[134]]
Concise summary of valuation for EuropeanOption
     value      delta      gamma       vega      theta        rho      divRho
   36.9574     0.9995     0.0001     0.2492    -2.9216    96.9723  -133.9296


[[135]]
Concise summary of valuation for EuropeanOption
     value      delta      gamma       vega      theta        rho      divRho
   37.9569     0.9996     0.0001     0.1962    -2.9195    96.9888  -134.9457
```

```
[[136]]
Concise summary of valuation for EuropeanOption
    value    delta    gamma     vega    theta      rho    divRho
  38.9565   0.9997   0.0001   0.1540  -2.9177  97.0016 -135.9582


[[137]]
Concise summary of valuation for EuropeanOption
    value    delta    gamma     vega    theta      rho    divRho
  39.9563   0.9998   0.0001   0.1204  -2.9164  97.0116 -136.9679


[[138]]
Concise summary of valuation for EuropeanOption
    value    delta    gamma     vega    theta      rho    divRho
  40.9561   0.9998   0.0000   0.0938  -2.9153  97.0194 -137.9754


[[139]]
Concise summary of valuation for EuropeanOption
    value    delta    gamma     vega    theta      rho    divRho
  41.9559   0.9999   0.0000   0.0728  -2.9144  97.0254 -138.9813


[[140]]
Concise summary of valuation for EuropeanOption
    value    delta    gamma     vega    theta      rho    divRho
  42.9558   0.9999   0.0000   0.0563  -2.9137  97.0300 -139.9858


[[141]]
Concise summary of valuation for EuropeanOption
    value    delta    gamma     vega    theta      rho    divRho
  43.9557   0.9999   0.0000   0.0434  -2.9132  97.0335 -140.9892


[[142]]
Concise summary of valuation for EuropeanOption
    value    delta    gamma     vega    theta      rho    divRho
  44.9556   0.9999   0.0000   0.0334  -2.9128  97.0362 -141.9918


[[143]]
Concise summary of valuation for EuropeanOption
    value    delta    gamma     vega    theta      rho    divRho
  45.9556   1.0000   0.0000   0.0256  -2.9124  97.0383 -142.9938


[[144]]
Concise summary of valuation for EuropeanOption
    value    delta    gamma     vega    theta      rho    divRho
  46.9556   1.0000   0.0000   0.0195  -2.9122  97.0398 -143.9954
```

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[[145]]
Concise summary of valuation for EuropeanOption
    value     delta     gamma      vega     theta       rho     divRho
  47.9555    1.0000    0.0000    0.0149   -2.9120   97.0410 -144.9965

[[146]]
Concise summary of valuation for EuropeanOption
    value     delta     gamma      vega     theta       rho     divRho
  48.9555    1.0000    0.0000    0.0113   -2.9118   97.0419 -145.9974

[[147]]
Concise summary of valuation for EuropeanOption
    value     delta     gamma      vega     theta       rho     divRho
  49.9555    1.0000    0.0000    0.0086   -2.9117   97.0426 -146.9981

[[148]]
Concise summary of valuation for EuropeanOption
    value     delta     gamma      vega     theta       rho     divRho
  50.9555    1.0000    0.0000    0.0065   -2.9116   97.0431 -147.9986

[[149]]
Concise summary of valuation for EuropeanOption
    value     delta     gamma      vega     theta       rho     divRho
  51.9555    1.0000    0.0000    0.0049   -2.9115   97.0435 -148.9989

[[150]]
Concise summary of valuation for EuropeanOption
    value     delta     gamma      vega     theta       rho     divRho
  52.9555    1.0000    0.0000    0.0037   -2.9115   97.0437 -149.9992

[[151]]
Concise summary of valuation for EuropeanOption
    value     delta     gamma      vega     theta       rho     divRho
  53.9555    1.0000    0.0000    0.0027   -2.9115   97.0440 -150.9994

[[152]]
Concise summary of valuation for EuropeanOption
    value     delta     gamma      vega     theta       rho     divRho
  54.9555    1.0000    0.0000    0.0021   -2.9114   97.0441 -151.9996

[[153]]
Concise summary of valuation for EuropeanOption
    value     delta     gamma      vega     theta       rho     divRho
  55.9555    1.0000    0.0000    0.0015   -2.9114   97.0442 -152.9997
```

```
[[154]]
Concise summary of valuation for EuropeanOption
     value      delta      gamma       vega      theta        rho     divRho
   56.9555     1.0000     0.0000     0.0011    -2.9114    97.0443 -153.9998

[[155]]
Concise summary of valuation for EuropeanOption
     value      delta      gamma       vega      theta        rho     divRho
   57.9555     1.0000     0.0000     0.0008    -2.9114    97.0444 -154.9998

[[156]]
Concise summary of valuation for EuropeanOption
     value      delta      gamma       vega      theta        rho     divRho
   58.9554     1.0000     0.0000     0.0006    -2.9114    97.0444 -155.9999

[[157]]
Concise summary of valuation for EuropeanOption
     value      delta      gamma       vega      theta        rho     divRho
   59.9554     1.0000     0.0000     0.0005    -2.9114    97.0445 -156.9999

[[158]]
Concise summary of valuation for EuropeanOption
     value      delta      gamma       vega      theta        rho     divRho
   60.9554     1.0000     0.0000     0.0003    -2.9114    97.0445 -157.9999

[[159]]
Concise summary of valuation for EuropeanOption
     value      delta      gamma       vega      theta        rho     divRho
   61.9554     1.0000     0.0000     0.0003    -2.9113    97.0445 -159.0000

[[160]]
Concise summary of valuation for EuropeanOption
     value      delta      gamma       vega      theta        rho     divRho
   62.9554     1.0000     0.0000     0.0002    -2.9113    97.0445 -160.0000

[[161]]
Concise summary of valuation for EuropeanOption
     value      delta      gamma       vega      theta        rho     divRho
   63.9554     1.0000     0.0000     0.0001    -2.9113    97.0445 -161.0000
```

Implied Volatility